FREE INSIDE! BLUEPRINT OF THE LEADER THREE

Practical Wireless

3D.

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AND PRACTICAL TELEVISION

EDITED BY F. J. CAMM

The LEADER 3
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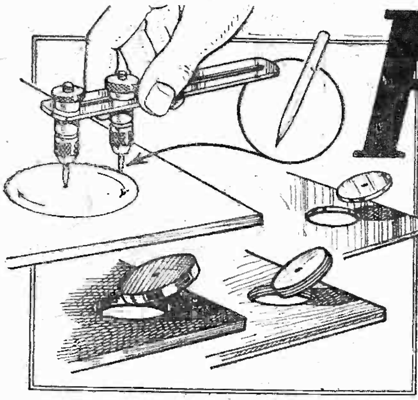


For a LIMITED
Our Greatest Gift Offer in response to many

SINCE the closing of our recent great Gift Offer of a complete Pocket Kit of Home-Constructor's Tools, expressly designed by the Editor of this paper, we have been inundated by requests from new readers who missed the offer but have seen the Kit and want to know where it may be bought.

We have had to reply in every case that the "Practical Wireless" Tool Kit was specially made for the Purpose of our Presentation Offer and therefore is unobtainable in the shops. However, in view of the obvious widespread disappointment thus occasioned, we have since arranged for a further supply of Kits identical in every respect

READ THESE SIMPLE CONDITIONS

All you have to do to obtain your Pocket Tool Kit is :—
(a) Complete the Forms on right in ink.
(b) Post Reservation Form and stamped address label.

On receipt of Reservation Form and the address label, we will send you a special Subscription Voucher on which to qualify for your Pocket Tool Kit. Your Kit will be reserved for you, and will be despatched immediately we receive the completed Subscription Voucher.

Affix to the Subscription Voucher which we post to you 4 Gift Stamps cut from the bottom right-hand corner of the back page of PRACTICAL WIRELESS for 4 consecutive weeks commencing this week. (Tool Kit Gift Stamp No. 1).

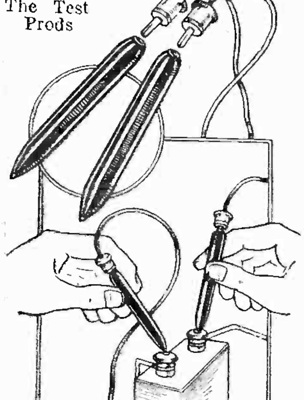
When your Subscription Voucher is complete, send it, together with a Postal Order for 3s. 6d., to include registration, postage, packing, insurance, etc., to PRACTICAL WIRELESS Presentation Department, and your Pocket Tool Kit will be despatched to you immediately.

No reader may qualify for more than one Pocket Tool Kit.

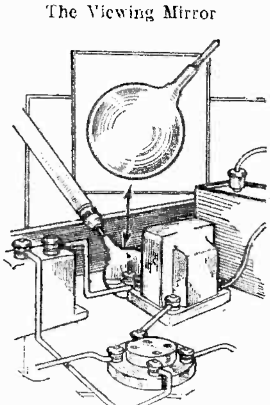
This offer applies to persons residing in Great Britain and Ireland. Readers in the Irish Free State must pay any duty imposed.

The Case, which is made of stout stamped metal, measures $6\frac{1}{4}'' \times 4''$. Recesses are provided for all tools and when loaded, the Kit slips easily into the pocket.

The Test Prods



The Viewing Mirror



Period only!

to Readers repeated urgent requests

with those previously issued, and these we now have pleasure in offering to our readers on even more advantageous terms than before. This time only 4 Gift Stamps (see Conditions) being required, applicants will therefore obtain their Kits *in four weeks only*.

Sufficient Kits have been obtained to meet the estimated demand, but it must be definitely understood that when these are exhausted no more will be available at any price or under any conditions. Prompt acceptance of this Offer is therefore essential.

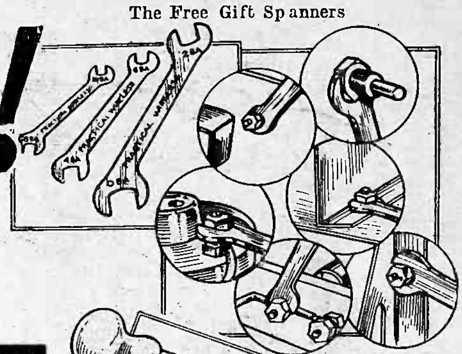
As to the Kit itself, this, as stated, has been specially designed by Mr. F. J. Camm, the Editor of this paper. It comprises in handy pocket form a complete battery of tools for the Wireless Constructor's use. Every tool is a sound engineering job. All of them, together with a few of their many uses, are illustrated in this announcement.

It is unnecessary to stress the extreme value of this Kit to the practical man. The tools alone, if purchasable in the ordinary way, would cost not less than 12/6, and being so ingeniously packed into the limits of their 6¼ins. by 4ins. Pocket Case, form an outfit which has only to be seen to be appreciated.

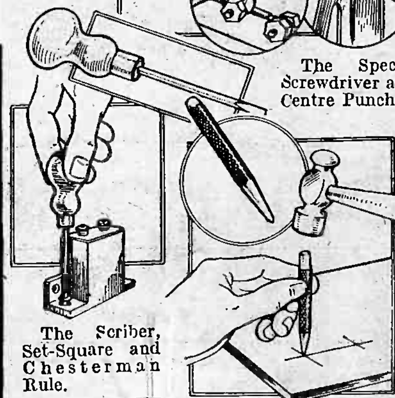
LIST OF TOOLS IN THE "PRACTICAL WIRELESS" KIT

1. One 4in. Spring Steel Chesterman Rule No. 300D-2.
2. One special Steel Scriber with adjustable Chuck for scribing point renewal.
3. One pair of special Ebonite Test Prods with Wander Plug Socket Ends and Brass Test Points.
4. One special 4in. Trammel with one fixed and one Sliding Head enabling circles to be scribed from 0 up to 3⅝ in. in radius. This tool may also be used for cutting holes in ebonite and baseboards too large to be drilled in the ordinary way.
5. One 60 degree 16-gauge Steel Set Square with Finger Fret, for easy use.
6. One special Viewing Mirror for inspecting obscure parts of the set. This Viewing Mirror fits into the Scriber Chuck.
7. One Steel Screwdriver with Brass Ferruled Handle, extremely useful for locking screws, securing components to baseboard, etc.
8. Three Steel Spanners 0-B.A., 2-B.A., 4-B.A., 6-B.A., 8-B.A., 10-B.A., fitting all or any standard size nuts and bolts used in Radio Construction.

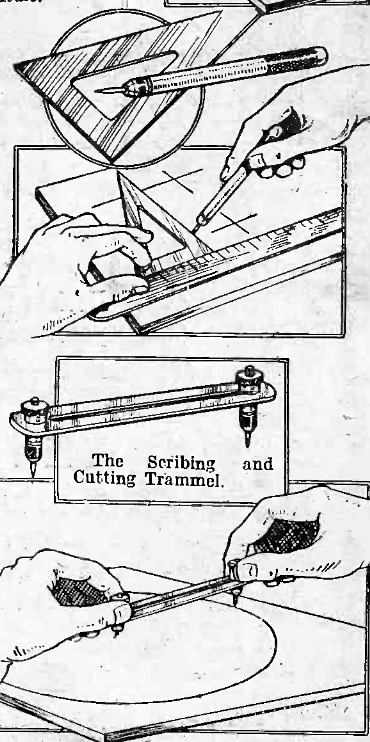
The Free Gift Spanners



The Special Screwdriver and Centre Punch.



The Scriber, Set-Square and Chesterman Rule.



The Scribing and Cutting Trammel.

If for any reason you failed to avail yourself of our previous Offer, do not let this opportunity pass you by. Fill in and post the Reservation Form now and thus *make certain* of securing your Kit.

NOTE: Post the Forms *at once*. Do not separate Address Label from Reservation Form. Write name and address clearly in BLOCK letters. Post in *unsealed* envelope, ½d. stamp only.

ADDRESS LABEL

If undelivered please return to Geo. Newnes, Ltd., 22, Tavistock St., Covent Garden, W.C.2

½d. Stamp must be affixed here.

Name ....

Street ....

Town & County ....

....

POST THIS RESERVATION FORM IMMEDIATELY TO

PRACTICAL WIRELESS

Presentation Department, T.K.

22, Tavistock Street, Covent Garden, London, W.C.2.

In accordance with the conditions of your special offer, please send me a SUBSCRIPTION VOUCHER on which to qualify for my Pocket Tool Kit. I have asked my Newsagent to deliver PRACTICAL WIRELESS regularly every week until further notice.

Reader's Name..

Full Address..

....

Newsagent ....

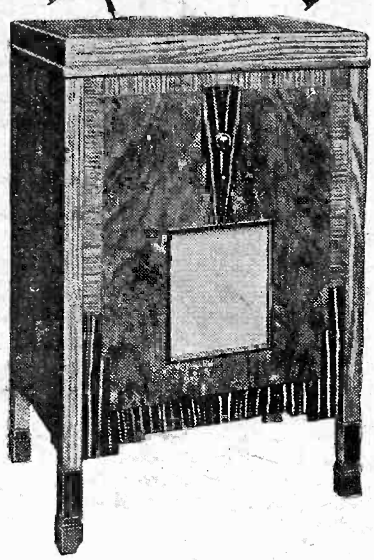
Address ....

Reader's Signature .... *Leave blank.*

Fill in this form and the label on left in Block Letters.

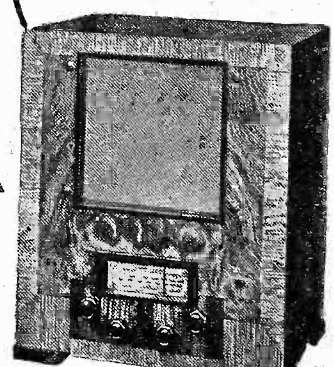
Stamp the label as directed and post both of them in an *unsealed* envelope (½d. stamp only required).

"HIS MASTER'S VOICE" BRING FIRST CLASS RADIO AND RADIOGRAMOPHONE TO ALL!



20 GUINEAS OR £1 A MONTH

12 GUINEAS OR £1 A MONTH



Perhaps first-class radio or radiogramophone has always been beyond you? It needn't be now! The greatest maker in the world has now produced these two superb instruments at your price! The Superhet Five-Forty radiogramophone! The Superhet Four-Forty Radio.

MADE TO MEET LUCERNE WAVE-LENGTH CHANGES

THE FIVE-FORTY

Radio History! Superheterodyne 5 valves (including rectifier) all-electric radio set and all-electric gramophone, combined in a beautiful modern cabinet of figured walnut. Silent-running electric motor with automatic stop and pick-up. Hinged to facilitate easy needle change. Tone control by which upper or lower registers can be accentuated. Selectivity of a very high order. New type "His Master's Voice" energised moving-coil loud speaker of balanced sensitivity at all registers. A.C. model 20 gns. (D.C. model 21 gns.) or small deposit and monthly payments of £1.

THE FOUR-FORTY

The Superhet Four-Forty is an achievement. It need only be compared with other sets to convince you of its superb Tone-quality, its Sensitivity and its Selectivity—perfect ability to separate completely the station you want from any other. There is volume without distortion. There is ease of tuning. There is a tone control by which upper or lower registers can be accentuated. The energised moving-coil speaker is of the latest type and mains can be used as an aerial. 5-valve (including rectifier) A.C. model 12 gns. D.C. model 13 gns. Or by hire purchase.

Ask your dealer about these two new all-important sets. They are the two exclusive interests today! Listen to the tone! Look at the cabinets! And then consider the prices!

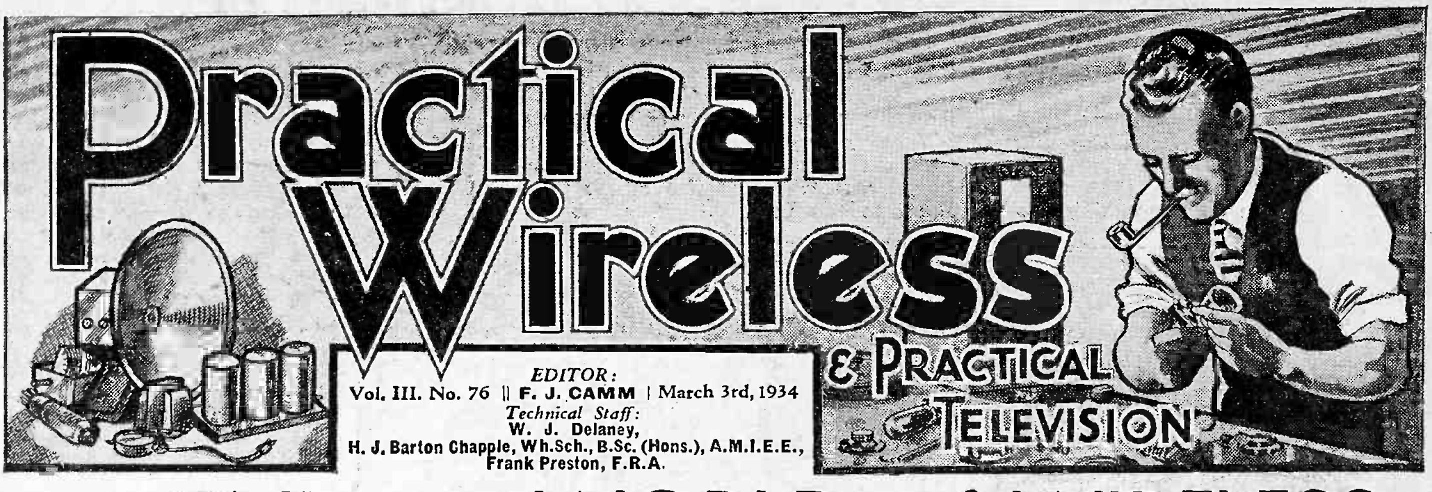
"HIS MASTER'S VOICE"

RADIO & RADIOGRAMOPHONES

Send a postcard immediately for special illustrated leaflet to

THE GRAMOPHONE COMPANY LTD. 108 L, CLERKENWELL ROAD, LONDON, E.C.1 PRICES DO NOT APPLY IN I.F.S.

WE LEAD AGAIN WITH "THE LEADER"— LOW PRICE COMBINED WITH EFFICIENCY.



EDITOR:
Vol. III. No. 76 || F. J. CAMM | March 3rd, 1934
Technical Staff:
W. J. Delaney,
H. J. Barton Chapple, Wh.Sch., B.Sc. (Hons.), A.M.I.E.E.,
Frank Preston, F.R.A.

ROUND *the* WORLD *of* WIRELESS

Low-power Relay Stations

IN order to provide a better broadcasting service, especially in Wales, the B.B.C. are considering the question of opening low-powered relay transmitters in various parts of the kingdom, of which one or more may be erected in Wales. In addition, for facilitating the taking of programmes from the Northern districts of the principality, it is proposed to establish a studio at Bangor. Wales was not included in the Regional scheme, as was Scotland, when this system was drawn up in 1927.

Six Millions—and Over

WITH the issue of roughly 1,100,000 wireless licences in January, the Post Office state that the number has now reached 6,124,000 as against 5,366,000 at the end of January, 1933. Although it is impossible to secure actual figures, it is now estimated that some thirty million people in the United Kingdom are listeners to the B.B.C. programmes.

Radio from the Rates

AT Eschbach, in Germany, in order to comply with the wish expressed by the Ministry of Propaganda that every household should own a wireless set, the Municipality has voted a gift to its employees of maximum 15 marks (at par 15s.) towards the purchase of a suitable receiver. The money is to be supplied by the communal rates !

Is This a Record ?

WHEN, on January 20th, the Vienna station relayed an act of the first performance of Lehar's new operetta, *Giudetta*, from the Opera House, the broadcast was taken by 133 transmitters in Europe and the United States.

United States Broadcast Licences ?

A SUGGESTION has been put forward in America to introduce a listener's licence ; it is anticipated that a minimum sum of twenty million dollars could be obtained in this manner. In addition, further income could be secured by taxing transmitters at an annual rate of 500 to 1,000 dollars, according to their power.

What is a Goosly ?

AT first sight most readers might think it was a member of the feathered tribe—but the goosly is a Magyar musical instrument ! In many ways it is a larger edition of the zither, and stands on four legs. To play it, you pluck the strings with the right hand, using a plectrum, whilst the left hand plays the keyboard. Walford Hyden, in his Katinka programme, to be broadcast on March 5th, will have one of these weird instruments in his orchestra. The entertainment comprises Russian peasant, soldier, and gipsy songs.

The "LEADER THREE" Introduces a New Set and a New Policy.
See Page 1096

UNRIVALLED SERVICE !

Every "Practical Wireless" Receiver is guaranteed to perform as claimed. Every Reader's question is answered free ! No other similar Reader Service exists. The finest technical staff in the world at your Service

FREE !

Another Attempt on the Stratosphere

ALTHOUGH so far the Russians hold the height record, another attempt is to be made shortly to elucidate still further the mysteries of the stratosphere. On this occasion the experiment will be carried out by Professor Moltchanov, of the Science Academy at Leningrad. The balloon will not carry any passengers, but will be of a true "robot" pattern ; the working of the various recording instruments will be started by radio from a land station. By this method it is hoped to attain an even greater height than hitherto reached without courting the risk of disaster with loss of life.

This Radio Racket

THE National and Regional programmes on March 5th and 6th will prove of interest to thousands of listeners, inasmuch as the radio revue transmitted will consist of truthful disclosures of what goes on behind the scenes of a broadcasting studio. The cast includes many well-known names, amongst which are found Doris Gilmore, Lawrence Baskcomb, Harry Hemsley, Philip Wade, John Rorke, and Fred Hartley.

The *Egypt's* Gold

ANOTHER new microphone play will be produced in the National programme on March 5th. It tells of the recovery by divers of a million pounds of bullion from the liner *Egypt*, which sank off Ushant on May 20th, 1922. Salvage operations were begun seven years later, but it was only in 1930 that the wreck was discovered. The B.B.C. sound effects department are promising a very realistic background to the drama enacted before the microphone.

Italian Broadcasting Network

TO permit a National broadcast through all transmitters when occasion arises, the Italian stations have now been amalgamated into two networks. The Northern group, which already included Genoa, Milan, Florence, Trieste, has been extended to Bolzano *via* Turin ; the Southern circuit now comprises Rome, Naples, and Bari, to which by special cable Palermo has been attached. Broadcasts from this studio will now be relayed from time to time to the Capital and other stations situated in the same network.

The Return of Johann Strauss

AUSTRIA, since the installation of its first broadcasting station, has steadily worked to increase the popularity of its late composers, and in particular has regularly transmitted in its programmes works by the Waltz King. During 1934 the Vienna studio proposes to broadcast every melody written by this prolific musician, including fifteen operettas, some of which have not been played for many years. The power of the new Bisamberg transmitter will permit them being heard over the greater part of Europe.

ROUND *the* WORLD *of* WIRELESS *(Continued)*

INTERESTING and TOPICAL PARAGRAPHS

On Exmoor with a Camera

"HUNTING on Exmoor — With a Camera" is the title of a West Regional talk to be given by Mr. Alfred Vowles on March 7th. In this talk Mr. Vowles will tell of his experiences in photographing deer on the moors and of his work in photographing birds.

Orchestral Concert from Folkestone

FOLKESTONE Municipal Orchestra's concert on March 5th will be relayed to London Regional listeners. The orchestra, which will be under the direction of Eldridge Newman, will be heard in Eric Coates's suite, *London Every Day*, and in a pot-pourri, *Tales from Strauss*. Soffie Schönning, soprano, will sing *Love Everlasting*, by Friml, and Adele's Waltz Song from *Die Fledermaus*, by Strauss.

Music-hall Broadcast by Stars of Yester-year

VETERANS of variety will be presented by Mr. John Southern in a "Music-hall" programme entitled *There is Gladness in Remembrance*, on March 3rd. These are no imitations, but the genuine articles; "stars" of yester-year singing their original "hits" in the way in which they sang them twenty or more years ago. Among the veterans whom Mr. Southern will bring to St. George's Hall for the broadcast are Tom Costello, Leo Dryden, Joe O'Gorman, and Charles Coburn. In addition, Sable Fern, Marie Kendall, Vesta Victoria, and Daisy Dormer will revive popular numbers with which their names are indelibly associated. With Mr. Southern as chairman, in the old style of presentation, the programme should provide an hour of real entertainment. Mr. Southern's most recent venture is the revival of Old-Time Music-hall at the Garrick Theatre, London, where he has made an outstanding success.

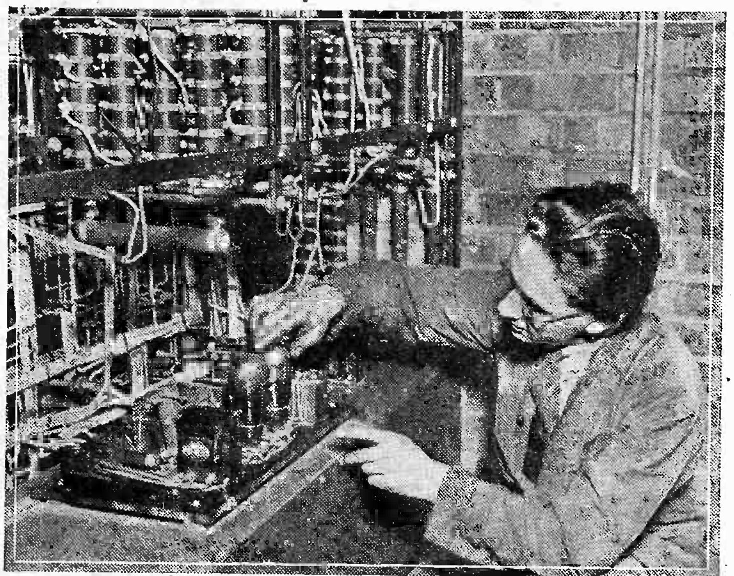
Massed Bands Concert

ON March 3rd, a massed band concert will be relayed to Midland Regional listeners from the De Montfort Hall, Leicester, where the city's eleventh annual brass band festival concludes. James Oliver will conduct. The programme includes Henry Hall's arrangement *Sweethearts of Yesterday*, the fantasia *Other Days*, by Gordon MacKenzie, and an arrangement of Three Hymn Tunes, by Handel Parker.

"Boyhood at Sea" Broadcast

WHILE apprentice in a sailing ship fifty years ago, Major Valentine Baker was washed overboard but landed back on deck by the following wave, saw a man fall from the foreyard arm to the deck and escape serious injury, and watched a shipmate who had gone overboard keep himself afloat by clinging to the leg of an albatross until a boat arrived. Major Baker is to give an account of his experiences in a Midland Regional talk, "Boyhood at Sea," on March 5th. After leaving the sea, he served in Warren's expedition to Mafeking in 1885, learned scouting from Selous, the famous hunter, and became one of the pioneers in Rhodesia in 1890.

CONTROLLING LIFTS BY WIRELESS VALVES



A new system of gearless drive has been introduced to England for the first time in a London building, where sixteen new lifts have just been installed. The interesting feature of this system is that two thermionic valves, such as are used in ordinary wireless sets, smoothly control the stopping and slowing of the lifts. The illustration shows an engineer replacing one of the thermionic valves.

Post Office Activities against Wireless "Pirates"

AMERICAN broadcasters have given the unlicensed listener in Great Britain a new name. In our home circle he is sometimes described as a "pirate"; but the Americans now call him a "bootlegger," and show some interest in the various campaigns undertaken by the British Post Office in order to trace and expose him. On both sides of the Atlantic, therefore, the news that the British Post Office is to undertake a new campaign next month may be received with interest. One direction finding van will pay a month's visit to the Cardiff, Newport, and Swansea areas, starting on March 5th, and listeners (or bootleggers) who are operating unlicensed wireless receiving apparatus in those districts should lose no time in obtaining the necessary licence from the nearest post office, thus removing the slur which our American friends have cast upon the name of the offenders.

"Tea Mixture"

THE first of a new series of Saturday afternoon concerts, *Tea Mixture*, will be broadcast from the Midland Regional on March 3rd. Artists new to the microphone, as in the recent *First Time Here* programmes, will take part, as well as old and tried favourites. A dance band will also appear and the first programme of the series will be compèred by a well-known Yorkshire comedian. Producer Charles Brewer is in charge of the series.

Alban Berg's "Wozzeck"

AN outstanding event of the B.B.C.'s season of Symphony Concerts at Queen's Hall is undoubtedly the first performance in England of the opera, *Wozzeck*, by Alban Berg, to be conducted by Adrian Boult on March 14th. Since its first performance in 1925 by the Berlin State Opera, *Wozzeck* has been repeated no less than twenty times in the German capital, a considerable number of times in provincial towns, such as Cologne, Oldenburg, and Mannheim, in Vienna and in America under Stokowski. It is the first opera by one of the younger contemporary school of composers to have received an international success.

Grousing over the Lucerne Plan

SOME readers have complained that certain European stations cannot always be found on the wavelengths officially allocated to them. This is true in specific cases where the transmitters have arbitrarily chosen their own channels, and discrepancies in the lists of wavelengths published, for this reason, will continue to exist until the whole matter has been cleared up. In regard to the long waves, a conference will shortly take place at Brussels, and it is to be hoped that on this occasion a better all-round agreement may be reached. So far, whatever interference exists on some European broadcasts, it is pleasing to note that most of the home stations are still unaffected; generally speaking, apart from minor incidental collisions, our channels have remained clear.

SOLVE THIS!

PROBLEM No. 76.

Jarvis had read that the impedance of an iron-cored choke varied with the frequency. He also understood that the equivalent impedance of a pure resistance did not vary with frequency. He therefore decided that he would obtain improved results if he used a resistance in place of a choke in the output filter of his receiver and he accordingly looked up the valve-maker's instruction sheet and found that the optimum load for his output valve was 8,000 ohms. He fitted a resistance of this value in place of the choke, but results were worse. Why? Three books will be awarded for the first three correct solutions opened. Address your attempts to The Editor, PRACTICAL WIRELESS, Geo. Newnes, Ltd., 8-11, Southampton Street, Strand, London, W.C.2. Envelopes must be marked Problem No. 76 and must be posted to reach here not later than the first post March 5th.

Solution to Problem No. 75.

Although all the wiring in Dobson's set was correct, the leads to the coils were bared at the end and in the case of one of the coils the coil-screen, when in position, made contact with one of the leads to the wave-change switch. Thus, when switched to the long wave position the switch was inoperative owing to the fact that the lead in question was earthed through the coil screen. The switch operated effectively when the screen was removed.

Only one reader successfully solved Problem No. 74, and a book has accordingly been forwarded to—

D. J. Moses, 34, Prichard Street, Tonyrefail, Glam.

HOW TO CONSTRUCT A SIMPLE CAPACITY BRIDGE

By W. L. PATTULO

A simple device for testing condenser capacities

THE small instrument about to be described can be made and calibrated with apparatus from every amateur's junk-box. It will give sufficient accuracy for all normal purposes and is quite easy to use. The meter will measure the capacity of any condenser, except the electrolytic variety, from 10 mfd. down to .0001 mfd. This range is covered in three steps.

It is not intended to discuss the theoretical circuit, which is given in Fig. 1, but for those who are interested it is sufficient to say that it consists of a simple resistance bridge, which is adjusted until the hum from the A.C. mains, or other source of oscillations, heard in the telephones, is balanced out. The unknown capacity can then be calculated from the formula :—

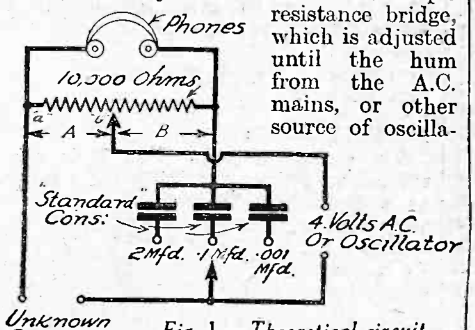


Fig. 1.—Theoretical circuit.

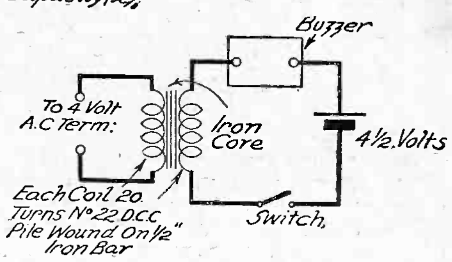


Fig. 5.—Method of using a buzzer to provide oscillations.

$$X = \frac{B \times C}{A}$$

where X = the unknown capacity in microfarads

B = the total resistance of the bridge in ohms, minus A

C = the standard capacity used, in microfarads

A = the resistance between the points "a" and "b" in ohms. See Fig. 1.

Parts Required

One 10,000 ohm potentiometer (Watmel).
One 2 mfd. condenser (T.C.C.).
One .1 mfd. condenser (T.C.C.).
One .001 mfd. condenser (T.C.C.).
Three Clix sockets with two coloured erinoid washers to slip underneath the heads.

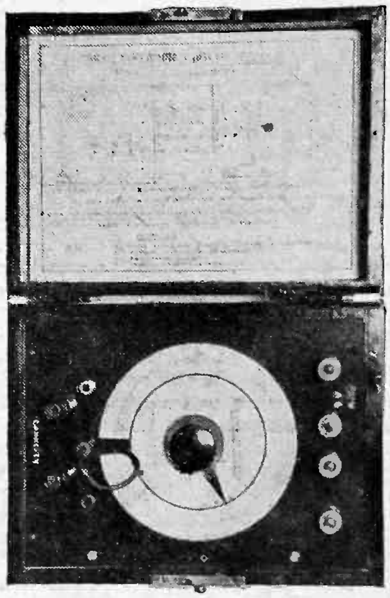


Fig. 4.—Photograph of finished instrument.

One Clix plug.
Ebonite panel about 8in. by 6in. by 3/16in.
Wood for case.
Wire.
Six terminals.

Auxiliary parts required, but which are not built into the apparatus, are a pair of headphones and a bell transformer. If the latter is not available, then the four-volt winding of the mains transformer in a wireless set can be used. The object of using the transformer is to isolate the apparatus from the mains and thus prevent the possibility of shocks. It is important to note that the frequency of the mains is used to provide the necessary oscillations, and therefore D.C. mains are unsuitable.

Lay-out and Construction

The lay-out adopted is not very important, but that shown in Figs. 2 and 3 was adopted by the writer. Note the use of a narrow baseboard at right-angles to the panel, for mounting the condensers and so saving space. When wiring up, be careful to avoid parallel or bunched-up wires, which may introduce unwanted capacity and make the calibration of the low-capacity range inaccurate.

Calibration

The next step is to calibrate the instrument. There are two ways of doing this. The first method is not quite so accurate as the second, but has the advantage of only requiring a pair of compasses to carry it out. The second method requires the use of an ohm-meter such as has been described several times in PRACTICAL WIRELESS. Those who have such an instrument are advised to use it.

Method No. 1

Prepare a circular paper or thin card scale, diameter about 3in., and draw on it two concentric circles with a radii of about 1¼in. and 1in. respectively. Fit the scale under the knob of the potentiometer and mark on it the two extreme points of movement of this knob.

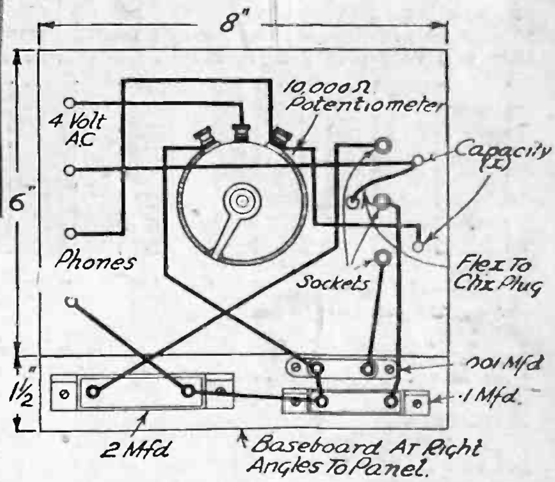


Fig. 2.—Sketch plan of lay-out and wiring diagram.

Divide up the portion of the scale over which the pointer of the knob travels into ten equal parts, and subdivide each of these into ten additional parts. Now each degree of the scale equals 100 ohms, therefore using the table given on page 1080, mark off the various resistances given. Print against each mark the capacities shown in columns 2, 3, and 4, using the inner circle of the scale for column 2 and the centre circle for column 3, etc. Figure 3 shows how the finished scale appears.

Note that the lowest resistance starts from the end of the potentiometer, which is connected to one of the terminals labelled "Capacity" (see Fig. 1), and that therefore the highest capacity readings on the scale will commence from this end. If coloured erinoid washers have been fitted under the Clix sockets on the panel, then the three sections of the scale should be labelled accordingly. The scale is now complete and may be glued down. A piece of

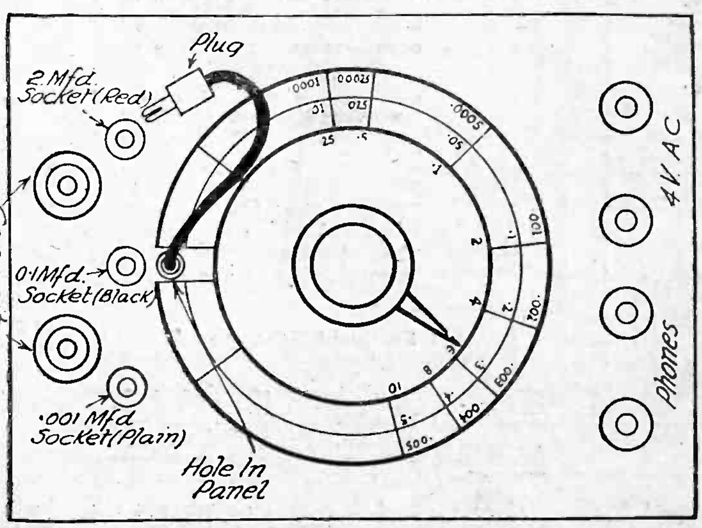


Fig. 3.—Top of panel showing scales. Note the extra long pointer on the knob.

(Continued on page 1080)

WILL THE PENTAGRID REVOLUTIONIZE THE SUPERHET?

The Pentagrid Valve is a Newcomer with Many Interesting Possibilities: Its Advantages are Interestingly Described in This Article by PERCY RAY

THE pentagrid is beginning to engage the attention of every serious constructor, and when news of this valve first became available it was taken for granted that it would revolutionize the superheterodyne, and yet it seems to have achieved little popularity up to the present. It is, therefore, not surprising that the constructor is losing confidence in the pentagrid and wondering if it is already dead. The writer is of the opinion that the pentagrid is far from dead, and feels that it will be a welcome addition when it is properly launched on the British market in a form designed to meet the requirements and conditions of this country. Before describing the unique working of this valve it is essential that the limitations of existing frequency-changers should readily be understood, and for this reason they will very briefly be reviewed.

Frequency Changing

The main difference between the superhet and all other types of receivers is that most of the amplification takes place on some predetermined wavelength other than that of the received signal; the incoming signal is made to beat with a locally-generated "carrier-wave" of such frequency that the resulting beat-note has a frequency corresponding to that of the I.F. amplifier. This wavelength mixing takes place in a stage generally called the frequency-changer, which may employ one or two valves, or, in certain exaggerated American superhets, three valves. Obviously, this stage is vital to the overall performance of the superhet, and it is probably true to say that 90 per cent. of the superhet receivers that have proved disappointing to their owners would be quite satisfactory if it were not for trouble in the frequency-changer.

The original form of frequency-changer consisted of a triode detector coupled to a triode oscillator. This arrangement possessed among its various disadvantages very low stage gain and a terrible tendency towards "dragging," which is the pulling out of tune of one tuned circuit by the other. It should be understood that the frequency-changer can actually amplify; in fact, the output from this stage can be so much greater than the input that a single I.F. stage may suffice, while with a poor changer two such stages would be necessary. All the various methods of frequency-changing will not be discussed in detail, as many of the minor variations have no real advantage over each other, selection being a matter of convenience only.

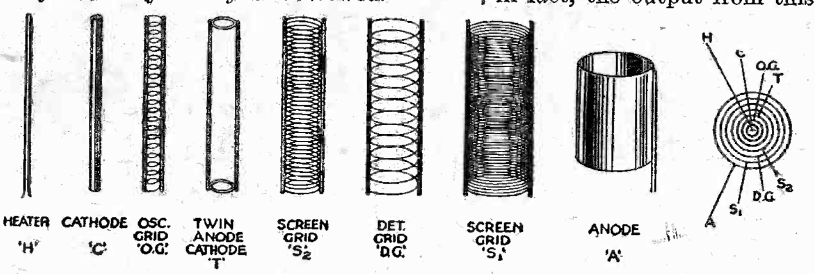


Fig. 2.—Showing the eight elements of the pentagrid valve. There are five grids in all. Note particularly the open structures of the grid marked "T."

The many forms of frequency-changers to-day make use of almost every form of valve either in pairs or singly in an autodyne changer, which is that form of circuit where a single valve performs the duty of detector and oscillator. In all these circuits couplings have to be provided whereby the signal and oscillator output are fed to the detector, and this leads to difficulties, while the use of a single valve is inclined to encourage the oscillator to "drag" the aerial circuit off tune. Both circuits are apt to radiate into the aerial, a state of affairs to be deplored, and it is well-nigh impossible to arrange a coupling where mixing is anything like uniform over the whole waveband and which does not give rise to that annoying falling-off in sensitivity at one end of the dial.

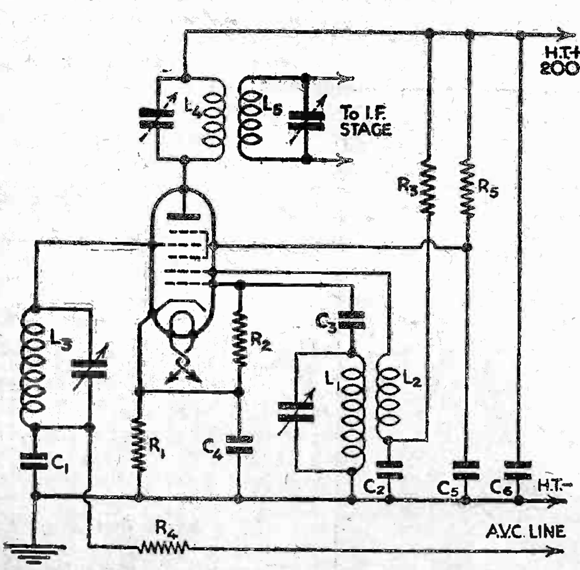


Fig. 3.—The circuit of the pentagrid frequency changer. R_5 is not mentioned in the text as it is merely to drop the 200v. to a lower value for the screen grids.

Uniform Efficiency on All Wavelengths

Whatever coupling is used, whether inductive, capacative, or both, it is bound to be more efficient at a certain frequency or frequencies, and the only truly uniform coupling is that provided by the pentagrid where electronic mixing is employed. This will readily be understood when the strange functioning of this altogether unorthodox valve has been described.

So far the grids S_1 and S_2 have been ignored for the simple reason that they do not materially interfere with the working of the valve; they are situated on the inside and outside of the signal grid and screen it from the other electrodes. This is a vital feature, as it prevents radiation into the aerial and stops interaction between the aerial tuning and

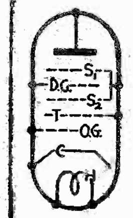


Fig. 1.—The schematic diagram of the pentagrid valve; the accompanying article explains the purpose of all these grids.

oscillator tuning circuits, and prevents one from dragging the other off its proper tuning point. The grids S_1 and S_2 may be considered as being similar to the screening grids in a screen-grid valve, and are joined together inside the valve, as shown in Fig. 1, and a single lead is brought out.

Pentagrid Circuits

The circuit diagram (Fig. 3) is one of several variations for using the pentagrid as a frequency-changer. The others are very similar, one makes use of a tapped coil in place of L_1 and L_2. In this circuit L_1 is the tuned oscillator-grid coil and is connected to grid "OG"; it is coupled to the oscillator anode "T" by means of the anode coil L_2.

L_4 and L_5 are the two windings on the I.F. input transformer, while L_3 is the aerial coil; it will be observed that the low potential end of this coil is taken away to the automatic volume control feed, the detector portion of the pentagrid having variable-mu characteristics permitting the smooth gain control associated with this type of valve. If A.V.C. is not used, the resistance R_1 can be variable to give manual control of volume.

R_1 is the bias resistance to apply the small fixed bias in the usual way, while R_2 gives a bias on the oscillator grid by reason of the voltage-drop across this resistor due to the passage of grid current through it. R_3 and R_4, in conjunction with C_1 and C_2, are for decoupling purposes; C_3 is a blocking condenser to prevent the partial shorting of the resistance R_2, and C_4, C_5 and C_6 are just ordinary by-pass condensers.

The pentagrid has many advantages, including the important one of electronic frequency-mixing, but there may be one point in favour of the two-valve method—greater amplification.

It has been suggested in one of our contemporaries that the pentagrid functions by virtue of a space charge, i.e., a cloud of electrons that, it is alleged, gather round the area of grid "T" (see Fig. 1) and form a "cathode" for the other half of the valve. It was suggested that mixing was achieved by virtue of the fact that the efficiency of the other part of the valve depended on the space charge the density of which was controlled by the oscillator grid "OG."

Since the electron cloud is in between two areas that are not crowded it could only be caused by the electron stream slowing up; the same effect is produced on a road,

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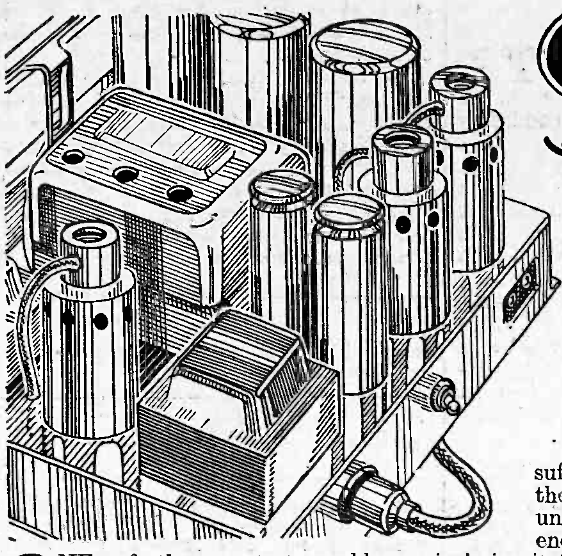

Screening Properly Explained

Too Often is the Subject of Screening Misunderstood by the Amateur Constructor. The Details Given in This Article Clarify the Situation

By H. J. BARTON CHAPPLE, Wh.Sch., B.Sc. (Hons.), A.M.I.E.E.

ONE of the greatest problems in receiver design is that of avoiding unwanted interaction between various parts of the circuit. Such interaction is similar in its effects to back-coupling, but, as we shall see, is due to other causes. Interaction is said to occur when energy, in one form or another, is transferred from one circuit or piece of apparatus to a second circuit, so that variations in the first are impressed as a spurious signal upon the second.

The trouble is that these spurious signals are amplified in succeeding stages of the set. At "the best" they spoil loudspeaker reproduction, but, if originally received from one of the later stages and fed back into an earlier stage, the re-amplification may be sufficient to upset the stability of the circuit and cause oscillation and howling.

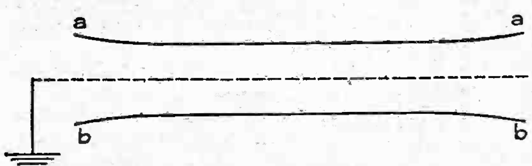

Fig. 1.—Showing simple electrostatic screening.

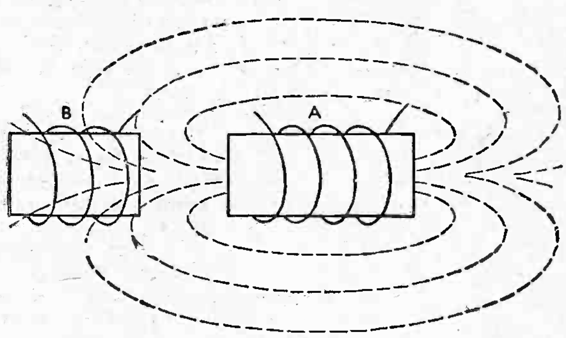

Fig. 2.—Magnetic field leakage between A and B.

Two Main Methods

There are two ways in which interaction may take place, namely, by magnetic and electrostatic coupling.

Magnetic coupling arises when the magnetic field of one circuit or component carrying an audio-frequency or radio-frequency current embraces part of another circuit. The whole arrangement acts as a transformer, alternating voltages being generated inductively in the coupled circuit.

Electrostatic coupling exists if conductors forming parts of two separate circuits are sufficiently close to each other to form the plates of a small condenser, for under these circumstances alternating energy will be transferred from one circuit to the other.

Not only may spurious signals be introduced in this way, but often the feeble but precious energy of the true signal may be dissipated, resulting in a loss of volume and power.

Two important points in connection with the design and layout of a circuit, which have a profound effect in avoiding interaction are, first, to see that wiring and components which might affect each other are well spaced apart, and second, that they are so disposed that their magnetic fields are not likely to interlink.

Indeed, in the earlier years of broadcasting these were the only precautions taken to avoid retro-action, and they were usually fairly efficacious because apparatus in general was comparatively insensitive, and the amounts of energy handled relatively small. Besides this, the losses due to interaction were usually masked by the still greater losses in the somewhat crude apparatus used.

Reducing Electrostatic Coupling

As the efficiency of individual components and receivers as a whole improved, however, and especially when A.C. mains operation was introduced and sensitive valves came into use, the effects of interaction became more noticeable. The complete solution to the problem was provided by combining sound layout and spacing with more or less complete screening of the various circuits.

Before describing the several methods of screening components and circuits, it is necessary to see exactly what effect screening has on the different kinds of interaction. First of all, then, consider how metal screening can reduce electrostatic coupling.

Fig. 1 shows two wires, aa and bb, which, it can be assumed, form parts of two different circuits. Suppose aa is carrying a radio-frequency signal (say the anode current of a high-frequency valve) and bb is part of the grid circuit of the same valve. If these two wires run side by side and are fairly close together, they will form a small condenser, and this will give rise to an unwanted feed-back or reaction. If, now, a metallic screen is placed between them and connected to earth, the wire bb will be isolated from the electrostatic field of aa, and energy cannot pass between the two circuits.

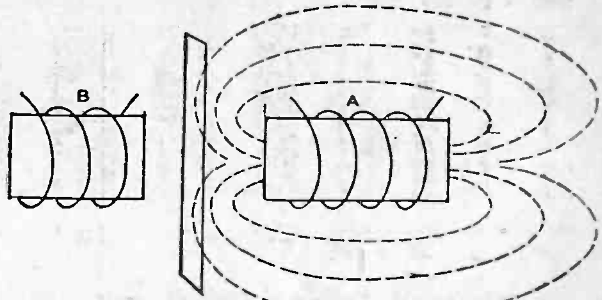

Fig. 3.—Employing an iron screen to "protect" B.

Note, however, that the wire aa and the screen now form a condenser, so that energy will be lost by the circuit aa by passing away to earth. Furthermore, there will be additional losses due to eddy currents being set up in the metal of the screen. These losses will be greater at high frequencies than at low frequencies, and it is therefore essential to combine the design of the screening with adequate spacing in order to minimize losses and eddy-current damping.

Magnetic Shielding

Magnetic interaction can, of course, be cured only by a screen of iron or steel—tin plate, which is tinned iron sheet, is also efficacious. But it is quite useless to try to prevent magnetic leakage from, say,

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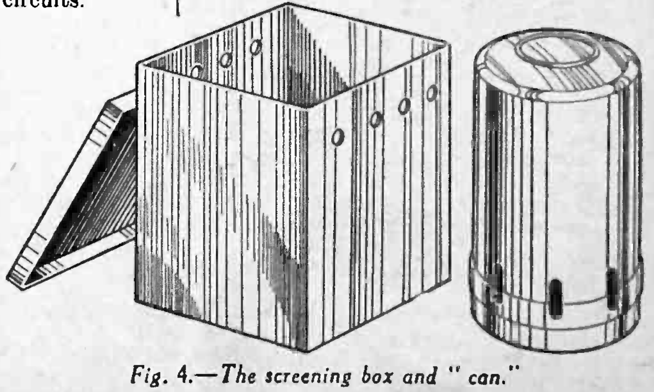

Fig. 4.—The screening box and "can."

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the power pack of an A.C. mains set by surrounding it with an aluminium screen. Even an iron screen is of little value unless it is of substantial thickness, and ⅛in. iron plate is the minimum thickness which can be really recommended.

Referring to Fig. 2 it will be seen that the magnetic field of A, say a low-frequency transformer or choke, cuts the circuit of B, which may be another transformer or choke. A voltage corresponding in frequency with that of the current in A will therefore be induced in B. When, however, an iron screen is interposed between A and B as in Fig. 3, the magnetic flux due to A is concentrated in the screen and does not reach B.

Screening Devices

It is now necessary to deal in detail with the principal screening devices which are available. The simplest form consists of built-up partitions of aluminium or tin plate arranged between the circuits it is desired to isolate from each other. This was the first type of screening to be employed and proved reasonably efficient with the older types of components.

Usually a metal sheet covering the baseboard, with transverse shields between the H.F. stages and a metal panel, gave a fair measure of shielding. It must be admitted, however, that a certain amount of interaction was still possible with such an arrangement, and it is an interesting conjecture as to what proportion of the "liveliness" of some of the 3-valve and 4-valve sets of the 1928-1929 era was due to the sensitivity of the circuits and what to the spurious reaction resulting from incomplete screening.

The next step came with complete screening boxes for various stages or individual components. Rectangular copper boxes were at one time popular, and then came the individual screening "can" as we know it to-day, see Fig. 4. The difficulty has always been to strike the best balance between bulk and efficiency. To avoid losses, the cans should be large, but considerations of space place restrictions on dimensions.

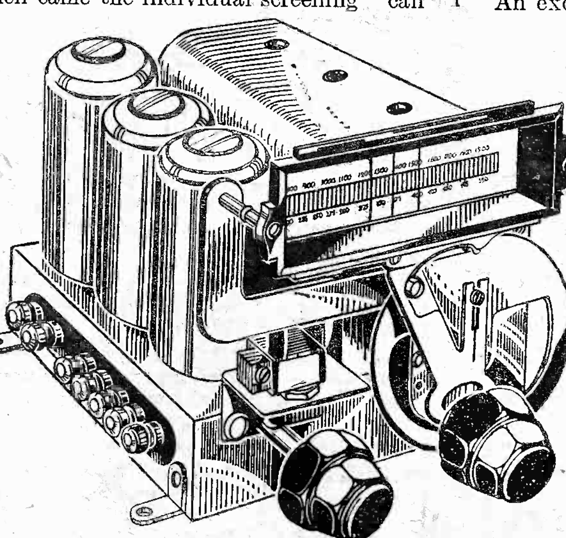


Fig. 5.—An example of a completely screened modern tuning pack.

High-water Mark

It may, however, safely be said that modern screened components of good make represent the best possible compromise, taking up only a reasonable amount of room, yet avoiding serious loss.

The high-water mark of canned components is reached in the modern tuning unit or pack, comprising all the coils and tuning condensers required for a highly-sensitive set, mounted upon a metal chassis, and with each coil and condenser element efficiently screened. A typical example is illustrated in Fig. 5.

Allied to the canned coil is the question of metallized valves. All H.F. and detector valves can now be obtained with bulbs which have been sprayed with a metal coating, this, in turn, being connected to one of the filament pins in the case of directly - heated valves, or to the cathode pin for indirectly-heated mains valves. This metal coating serves the same purpose as an effective screening can.

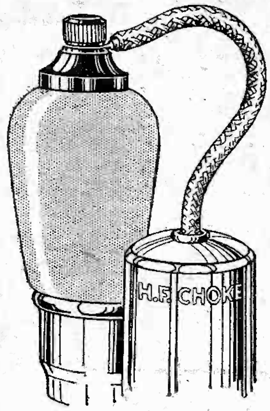


Fig. 6.—Using a screened wire for connection to the anode cap of an S.G. valve.

Fig. 7.—Single core cable in systoflex metal braiding.

In order that all screens and cans shall be at the same (earth) potential, it is usual to mount them upon a metal base. This may be achieved by placing a sheet of metal plate or foil on the top surface of the baseboard, or a chassis of metal sheet may be used instead of a baseboard.

Other Cases

An excellent and convenient alternative that has come greatly into favour during recent months is the wooden base or chassis heavily impregnated with metal, such as the "Metaplex" baseboard. These metallized bases re quite easily worked with ordinary wood working tools, and good electrical contact is produced by ordinary wood screws.

Mention must now be made of methods for shielding individual wires. It frequently happens that a single wire should be screened—for example, the connection to the anode cap of a screened grid valve (see Fig. 6), or the connection from the aerial terminal to the first H.F. grid, or some other wire carrying signal current. Various forms of metal-covered sleeving are available, but in making a choice it is wise to remember the following points: The actual wire must be insulated, and the screening metal earthed, while to avoid losses the metal cover must be of large diameter compared with the wire. Probably the best combination is a *thin* connecting wire enclosed in fairly wide bore systoflex and covered over-all in one of the many forms of metal sleeving (Fig. 7).

Handy makeshifts for the metal sleeving can be devised by means of a wrapping of metal foil, or even by winding bare wire closely over the systoflex. Finally, mention must be made of the practice of using metal-braided flex for the heater circuits of A.C. mains sets. Obviously, with the usual tinned copper braiding no magnetic shielding results. Probably the only effect of the braiding is to keep the two twisted cores as close together as possible, and thus to restrict the magnetic leakage. At any rate, I have used both metal-braided and ordinary twin twisted flex for different sets and have never found any noticeable difference in performance between the two.

(*Continued from page 1077*)

celluloid fitted over it improves the appearance.

1. Resistance in ohms of "ab"	2.	3. Standard Condenser.	4.
	2 mfd.	.1 mfd.	.001 mfd.
1666	10 mfd.	.5 mfd.	.005 mfd.
2000	8 ,,	.4 ,,	.004 ,,
2500	6 ,,	.3 ,,	.003 ,,
3333	4 ,,	.2 ,,	.002 ,,
5000	2 ,,	.1 ,,	.001 ,,
6666	1 ,,	.05 ,,	.0005 ,,
8000	.5 ,,	.025 ,,	.00025 ,,
8888	.25 ,,	.01 ,,	.0001 ,,

Prepare a circular scale as in method No. 1. Connect an ohm-meter across the potentiometer at points "a" and "b" of the circuit and adjust the potentiometer until the first reading given in column I of the table above is obtained on the ohm-meter. Mark the scale at this point and repeat the process for the remaining readings. Complete the scale by printing on the capacities, etc., as in Method No. 1.

The table above is worked out for each of the twenty-four different capacities from the formula referred to at the beginning of this article, by solving the equation for "A." The apparatus can therefore be calibrated for any other capacities by substituting the desired capacity for "X." The resulting value for "A" will give the resistance at which it is necessary to set the potentiometer in order to balance out the oscillator note for the capacity under test.

It is important that the value assigned to "C" be reasonably near that of the condenser to be measured, otherwise the resistance "A" or "ab" will be too near one end of the scale to obtain a true silent point.

Connect a pair of high-resistance headphones and the low-voltage winding of a bell transformer, or other source of oscillations, to their appropriate terminals. Join the condenser under test to the terminals labelled "Capacity" with short lengths of wire (not twisted flex), and insert the Clix plug into one of the sockets. Switch on the oscillator and adjust the potentiometer knob carefully until the note heard in the phones is balanced out. It should be possible to find a point which is quite silent, but where a slight movement of the knob either side will make the oscillator note audible again.

If no silent point can be obtained, transfer the Clix plug into each of the other sockets in turn and repeat the process.

It is desirable, though not essential, to use a high note oscillator in preference to the A.C. mains when using the low-capacity range. This is principally because the low-frequency hum from the mains does not readily pass the small-capacity condensers used in the circuit.

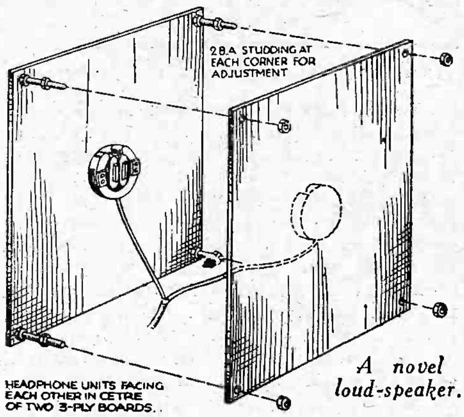
A simple oscillator, incorporating a buzzer, which the writer has used with success, is given in Fig. 5.

READERS' WRINKLES

THE HALF-GUINEA PAGE

A Cheap and Novel Speaker

THE components required for the novel speaker illustrated are: 4 lengths of 2BA threaded rod and 8 2BA nuts; 2



A novel loud-speaker.

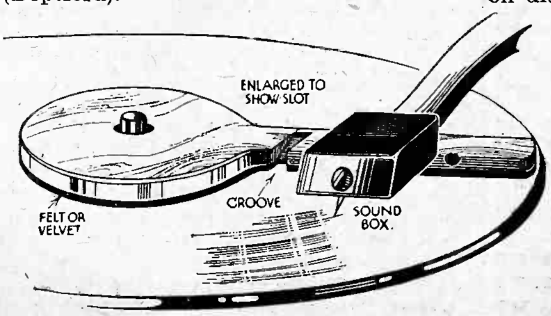
pieces of thin plywood, 18in. square, and a pair of 'phones.

The 'phone magnets are removed in their entirety from their cases and mounted in the centres of the plywood squares, so that when placed together the magnets attract each other. If they do not, reverse the magnets (quite a distinct pull can be felt). A hole is then drilled in each corner of the squares. Replace the leads to the earpieces, screw two 2BA nuts on to each rod and assemble the parts as shown. Thread on the outside the remaining 2BA nuts, and, by means of the threaded rod, adjust till the magnets are practically touching. Lock with the outside nuts and, except for a coat of varnish on the squares, the speaker is complete.—P. TEMPLE (Hull).

Protective Device for Gramo. Records

IT often happens that the gramo. needle, after finishing on the recording surface, skids out of the groove made for it, with subsequent damage to the record. The simple device shown in the sketch, which easily overcomes that trouble, can be made from thin plywood, ebonite, or bakelite. One side could be covered by felt or velvet which would act as a brush.

In operation the needle is placed against the "board," and on completion slips into the groove and is then raised off the record surface by the chamfered slot and retained by the small vertical portion.—D. JONES (Deptford).



A simple protective device for gramo. records.

THAT DODGE OF YOURS!

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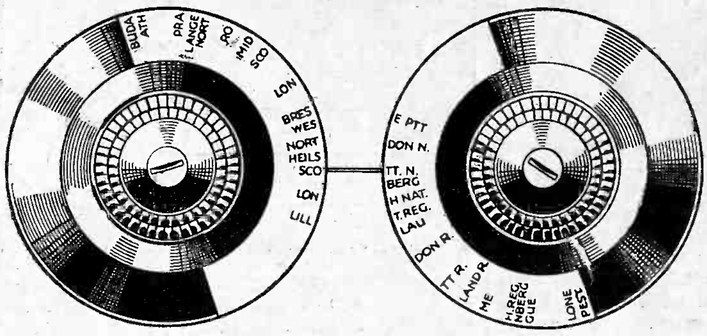
An Easy Tuning Device

THE following method of calibrating and marking of dial readings for a two-knob tuner will prove very simple and effective. First, cover the degree markings on the condensers with a piece of cartridge paper cut out to shape. Having switched

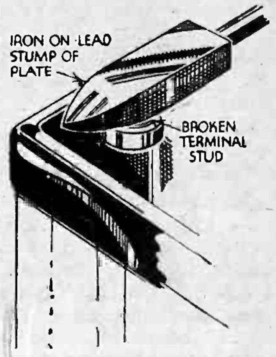


An effective tuning arrangement.

on set, turn knobs until a station is heard. These can easily be identified now, by call signs, tuning notes, language, etc. If a doubt exists, reference can be made to the daily advertised programme, and verified by the item being broadcast. Having satisfied himself as to the station he is receiving, the operator should proceed to mark dial settings in the following manner. The left-hand condenser dial should be marked with first part of station name, and right dial with the second half of name in continuation. When this has been done at each position where a station has been received, tuning-in afterwards becomes the simplest of motions. Merely rotate both knobs until the name of station shows on dial.—VICTOR DEAN (London, S.E.15).

Removing Broken Terminals from H.T. or L.T. Accumulators

IT sometimes happens that accumulators with good plates in them cannot be used because a terminal has broken in (generally the positive). A quick and easy method of removing the broken part is to pour a little killed spirit, or spirit of salt, around the broken stump and then press on it with a hot soldering iron for a few seconds, keeping the iron flat and completely covering the stump. The iron expands the lead stump of the plate and the killed spirit runs inside and sends all corrosion and sulphation, which previously held the terminal stump fast, to the top. With a sharp-nosed pair of pliers it is then an easy matter to remove the stump. Care must, naturally, be exercised with celluloid accumulators.—H. KAY (Royton).

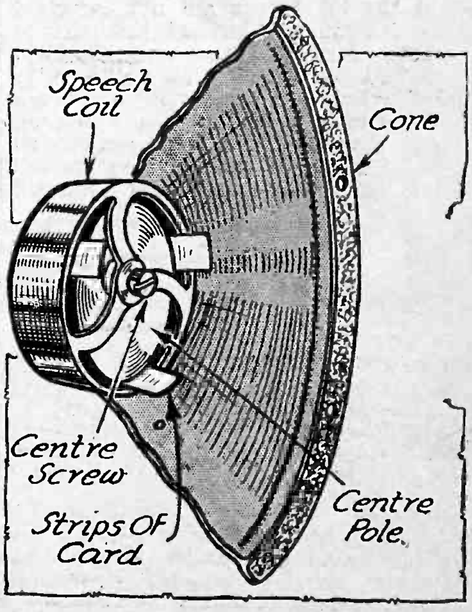


Method of removing broken terminals from accumulators.

Centring M.C. Speaker Speech Coils

HERE is a simple method of centring the speech coil of a moving-coil loud-speaker.

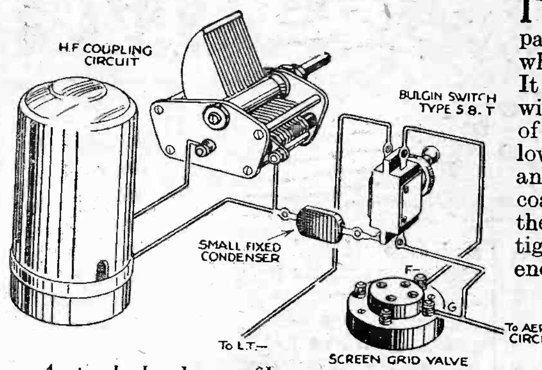
First loosen off screw holding the spider to centre pole, then insert three pieces of cigarette card or paper (according to the size of the gap) about ¼in. wide, at equal distances round the centre pole, and on the inside of speech coil. Tighten up the screw and remove cards, when the speaker will be found to be correctly centred. If the spider is damaged a temporary repair may be effected by lightly packing cotton-wool in the gap, to prevent chatter.—L. R. TYLER (Oswestry).



Centring a speech coil in an M.C. speaker.

READERS' WRINKLES

(Continued from page 1081)



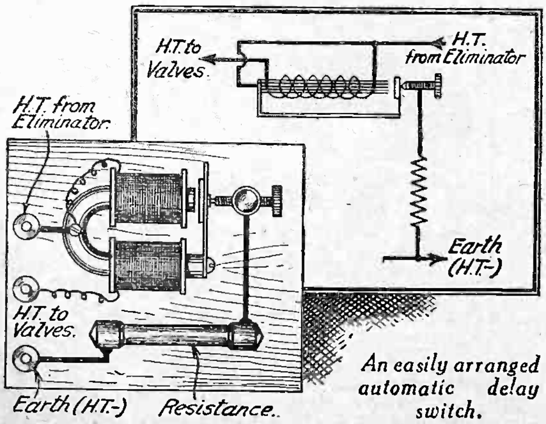
A simple band-pass filter arrangement.

A Simple Band-pass Filter

HAVING on hand a two-way Bulgin snap switch, I devised the switching arrangements shown in the accompanying sketch, whereby the S.G. valve of my set is cut out and at the same time a small capacity condenser is brought into circuit across the fixed terminals of the tuning condensers. An efficient band-pass filter is thus formed which will bring in the locals and many of the more powerful foreigners at excellent quality, at the same time saving the current that the S.G. valve would have consumed.—J. H. WYLDE (Marsden).

Automatic Delay Switch

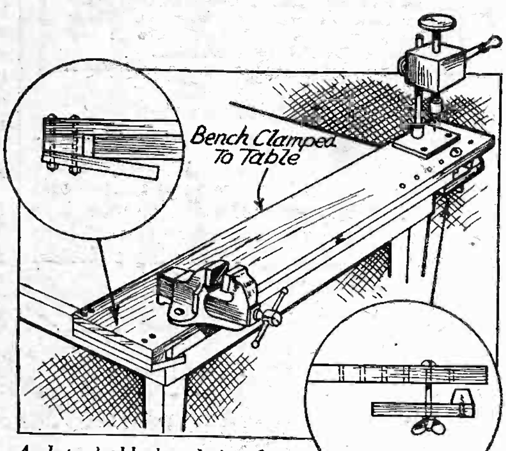
SOME A.C. set builders will perhaps welcome a simple alternative to the thermal-delay switches which are on the market. The device illustrated, which is fairly easy to construct, has the advantage of earthing the H.T., through a big resistance, until the valves are in a condition to receive the full load. It consists of a resistance the actual value of which is determined by the consumption of the set, and a small relay. The coils and magnet of the relay may be taken from an old bell, the coils being rewound with about 1,500 turns each of 38 s.w.g. wire. The accompanying diagram will explain the constructional details. An important point is that the tension on the armature should be adjustable to determine the actual point of operation; this can easily be done by arranging a small spring as shown in broken lines. The operation is as follows:—When the relay coils are not energized the resistance is connected through the contact to earth, thus preventing the H.T. from "building up." When the valve cathodes heat up, current flows through the relay coils, which are then energized. This breaks the contact, cutting the resistance out of circuit and applying the full load to the valves.—J. CHURCH (Arlesey).



An easily arranged automatic delay switch.

A Universal Bench

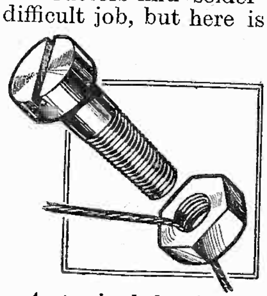
IT is often difficult to find room for a bench in the house, and the accompanying sketch shows a detachable one which can easily be fitted to any table. It merely consists of a board about 9in. wide and 4ft. or 5ft. long, fixed to the top of a table as in sketch. One end has a lower piece about 8in. long fixed at an angle to the top and held by two or four coach or countersunk bolts. The bench is then pulled on to the table until this end is tight. Then the lower part of the other end is pushed up on the bolt, which may be placed in the most convenient of the holes provided, and the wing nut tightened. Since all the wear and tear comes on the front of a bench, this "makeshift" will be quite wide enough. A piece of newspaper should be placed on the table before the bench. It will protect the table and serve to collect dirt.—JAMES H. ROWE (Dublin).



A detachable bench for fixing to a table top.

A Nut-locking Hint

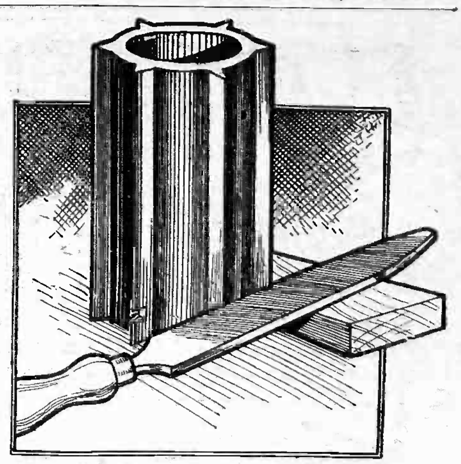
MOST amateur constructors find soldering a rather difficult job, but here is a simple method of securing nuts without resorting to the soldering iron. First, dip a piece of thin twine in shellac, and then pass the twine through the nut (as in sketch) and screw the nut on with the twine between. This method will effectively lock the nut if the shellac is wet when the nut is screwed on. The ends of the twine can then be cut off.—P. H. LOVELL (Honor Oak).



A simple dodge for locking nuts.

Slotting Ribbed Coil Formers

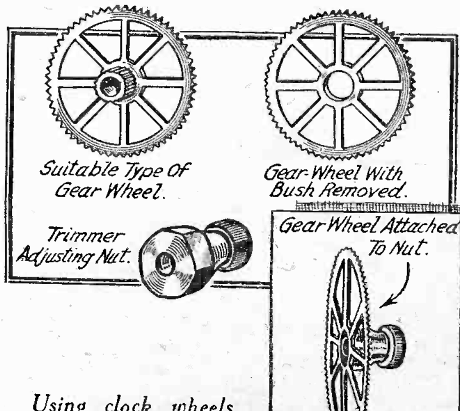
FOR those who are desirous of matching home-made coils on a six-ribbed ebonite former, the following dodge will ensure that the windings are identically spaced on each coil. It is usual to wind the long-wave section in slots in the bottom part of the coil, and the medium wave winding as a plain solenoid. A reaction winding will also be required on some coils, and possibly a small aerial coupling winding for the medium waves. A few scraps of oak are all that are required. It is advisable to leave a space of about half an inch at the bottom of the former to accommodate terminals or soldering tags. A flat piece of oak therefore, ½in. thick, is screwed to the bench, and the former held firmly against this and resting on the bench. A slot is then cut in each rib with the edge of a flat file. The file resting on the piece of wood whilst it is cutting. The file should be about ⅛in. thick, which will give a suitable winding space for as many as a hundred turns of, say, 34 enamelled wire, if each slot is cut to half the depth of the rib. For the second series of slots, a piece of ¼in. oak is now screwed on top of the first one so that the front faces are flush, and the cutting process repeated, keeping the file riding flat on the wood. If more slots are required, additional pieces of ¼in. wood are screwed on the top of the preceding ones.—L. PITCHFORD (Normanton).



A method of slotting ribbed coil formers.

Trimming Ganged Condensers

I RECENTLY acquired a ganged condenser assembly on which the trimmers were adjusted by means of hexagonal-headed nuts the size of ordinary terminal nuts. With the condenser mounted it was most inconvenient to adjust the trimmers with ordinary spanners in such a manner as to effect proper adjustment, so I detached the ganged unit and removed the adjusting nuts. From a broken alarmclock I secured two brass gear-wheels of equal size and removed the bushes, thus leaving a hole in the centre of each. These I sweated on to the ends of the adjusting nuts, the holes being concentric. On replacing the nuts-cum-gear-wheels, trimming became simplicity itself, the wheels being moved round either way by means of a long wooden rod with one end flattened.—T. D. RAMSAY (Sterkspruit, South Africa.)



Using clock wheels for trimming ganged condensers.

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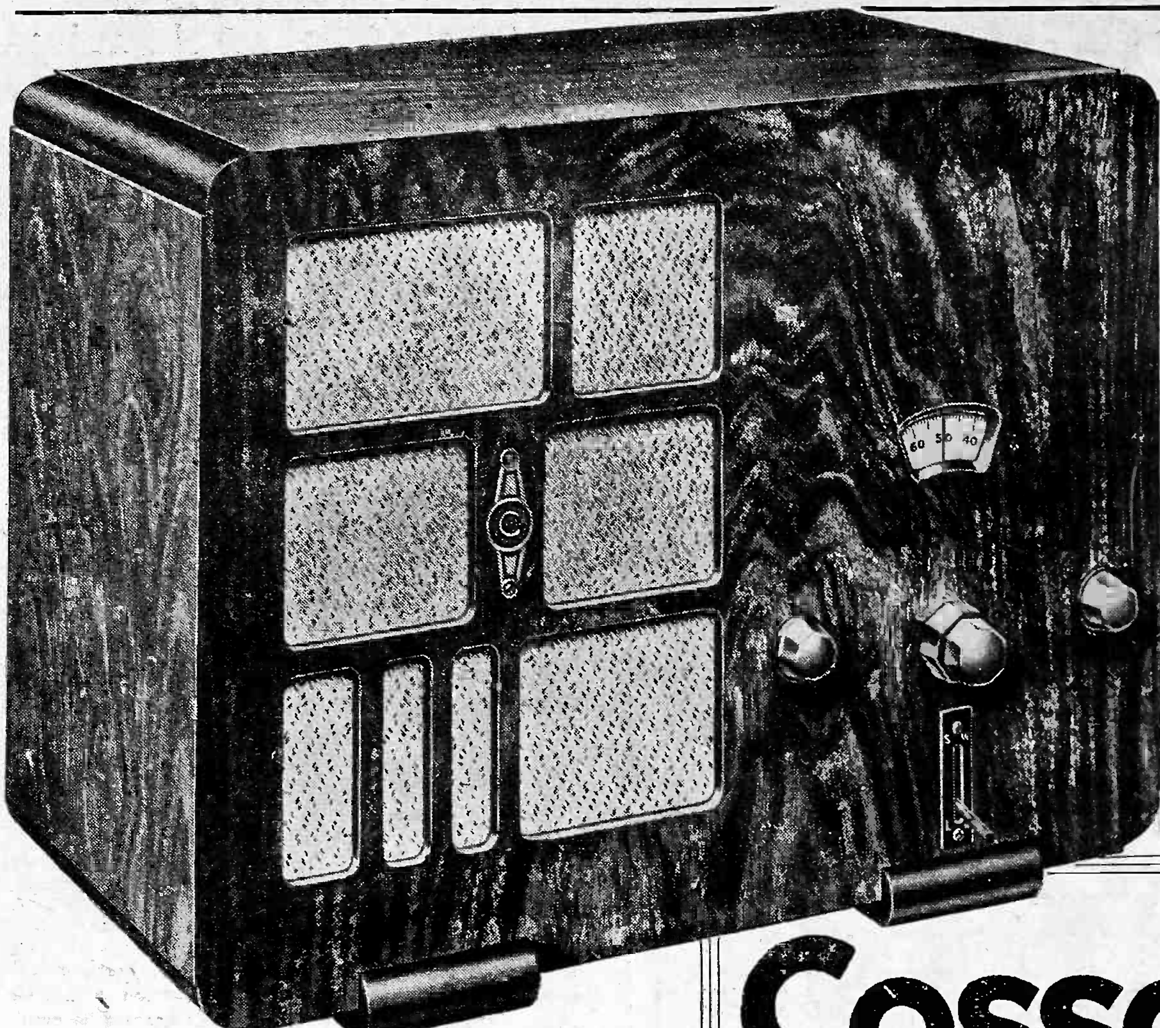

Illustration shows Models 342, 344 and 347. Model 341 has similar cabinet but with Loud Speaker adjustment in centre of fret.

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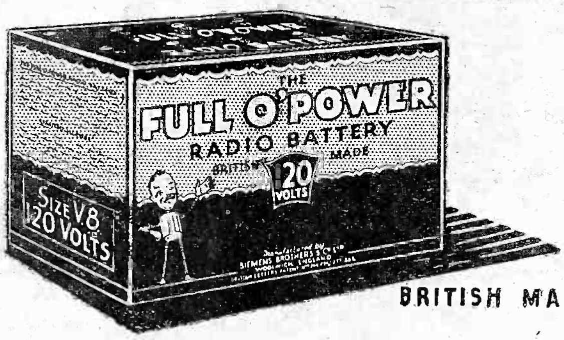

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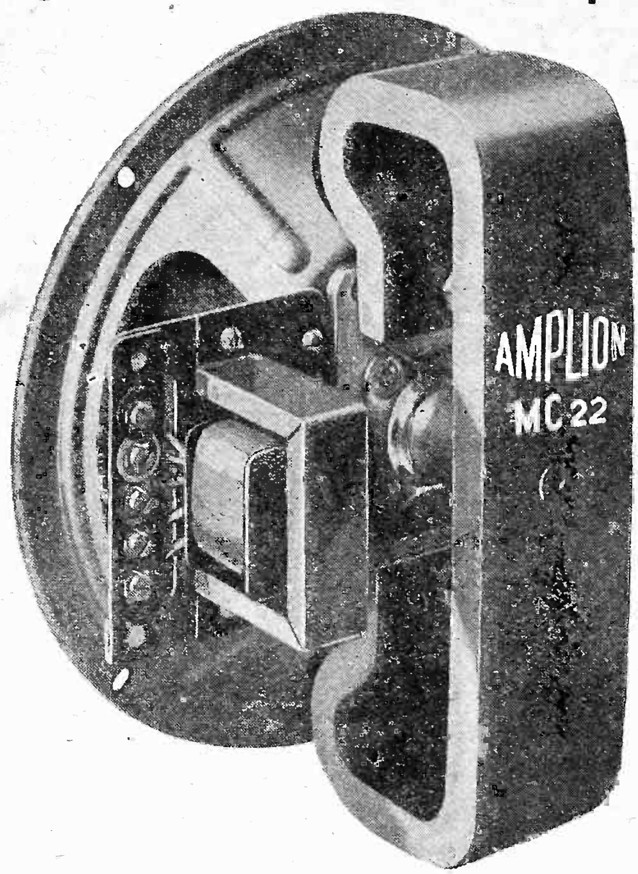

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DYNATRON OSCILLATORS AND THEIR USES

An Interesting Explanation of the Dynatron Principle with Some Practical Information in Regard to the Construction and Use of Dynatron Oscillator.

By K. E. BRIAN JAY

If the electrons emitted by the hot filament of a valve strike the plate sufficiently hard they will knock electrons out of the metal of the plate, and so set up a secondary electron stream in the opposite direction to themselves. By raising the grid of the valve to a higher D.C. potential than the plate, as in Fig. 1, the speed of the filament or primary electrons is accelerated, so that they knock more electrons from the plate and increase the stream of these secondary electrons, which are attracted to the grid. The result of this is shown in the plate volts-plate current curve of Fig. 2. As the plate voltage is increased, the plate current (measured by the milliameter M) increases until it reaches the point A, at which secondary electrons begin to be liberated. Beyond A an increasing number of secondary electrons are set free which return to the grid and so reduce the total plate current until the point B is reached at which the plate voltage approaches that of the grid and the potential difference is no longer sufficient to draw the electrons to the grid. We see then that over the part of the curve between A and B the valve has the unusual property of passing less current the more the voltage is increased, a condition called negative resistance. This effect was first described in 1918 by A. W. Hull, who gave to it the name dynatron; he found that improved dynatron effect could be obtained by putting a fourth electrode (shown dotted in Fig. 1) into his valve, which he then called a pliodynatron, although dynatron is the commonly used term now. Little practical use of the effect was made until the introduction of screen-grid valves made it easy to obtain valves having dynatron characteristics. The curves of Fig. 2 are actually those of a 2-volt screen-grid valve drawn for a fixed screen-grid voltage, and control-grid voltages of 0 and − 1.5 volts.

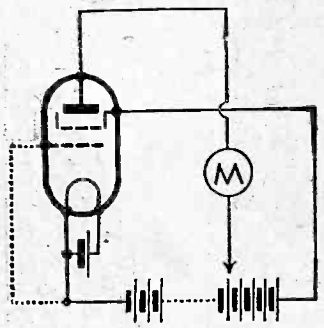
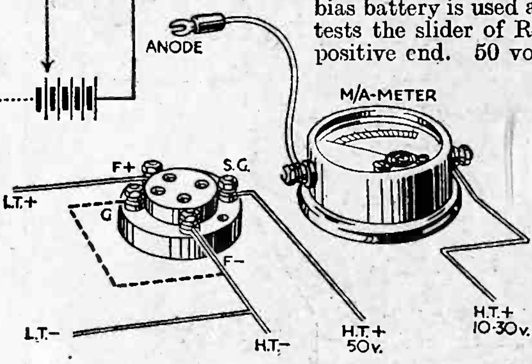


Fig. 1.—This circuit shows the connection to the fourth electrode in the dynatron oscillator.



Operating the Dynatron

The utility of the device lies in the fact that a tuned circuit will oscillate when it is connected across a negative resistance if its resonant impedance is greater than the negative resistance. The dynatron provides a simple negative resistance that has the advantage that it is easily varied by altering the bias on the control grid; the negative resistance is equal to the reciprocal of the slope of the curve AB, so that decreasing the slope increases the negative resistance, and from Fig. 2 it is clear that the slope of the curve is decreased when the control-grid bias is made more negative. A practical version of the arrangement is shown in Fig. 3; C_1 and C_2 are 1 mfd. bypass condensers, R_1 a 5,000 to 10,000-ohm variable potentiometer to provide fine control of the control-grid bias, C_3, a variable condenser of .0005 mfd. or less, depending, like the coil L_1, on the wave-length range required. A six-volt grid bias battery is used and for the preliminary tests the slider of R_1 should be set at the positive end. 50 volts H.T. on the screen grid will suit almost any valve, but the voltage on the plate is rather more critical although it will probably be between 10 and 30 volts. To find out whether the dynatron is working, a coil covering the 200 to 500-metre broadcast band should be placed at L_1 and the broadcast receiver tuned to the local station; C_3 is then rotated until a heterodyne whistle is heard in the loud-speaker; if there is no whistle the plate voltage is altered until it appears. Most mains or battery screen-grid valves work satisfactorily, high conductance valves being the best, but pentodes are quite useless because the third grid has been introduced for the express purpose of removing the dynatron kink.

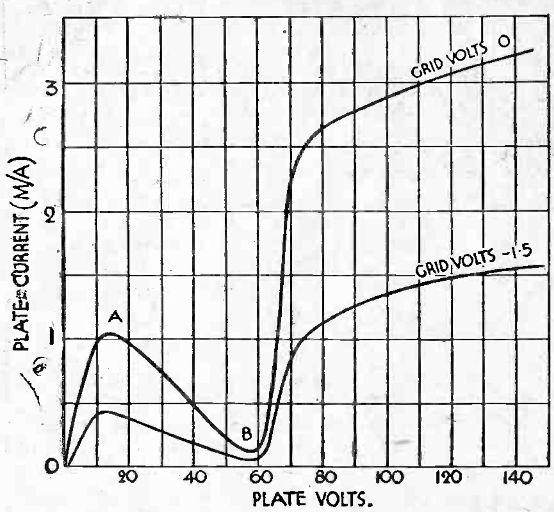
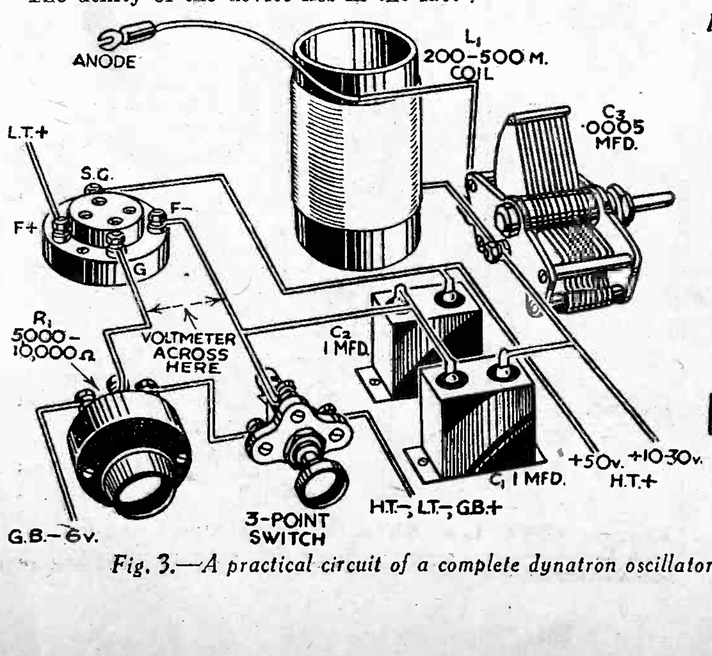


Fig. 2.—Plate volts-plate current curves for an S.G. valve.

For Comparing Coil and Condenser Efficiencies

When the valve is oscillating, increasing the negative grid bias by moving the slider of R_1 to the negative end increases the negative resistance, which approaches the impedance of the tuned circuit L_1C_3 until, when they are just equal, the oscillations cease; decreasing the negative bias should cause the oscillations to restart immediately; if they do not, backlash is present and may be removed by adjustment of the plate voltage. When properly adjusted the oscillator provides an excellent means of testing the relative "goodness" of coils and small condensers. To compare two coils one is connected in place of L_1 and tuned by C_3 to give a beat note with a station tuned in on the receiver; the grid bias is then increased by adjusting R_1 until the valve just stops oscillating, when the bias voltage is read on the voltmeter shown dotted at V in Fig. 3. The second coil is then put in place of the first and the



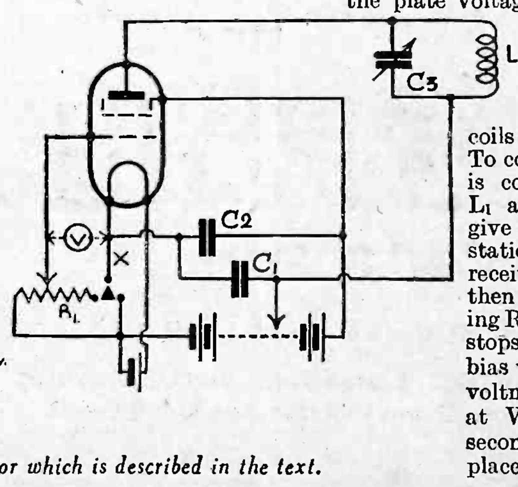
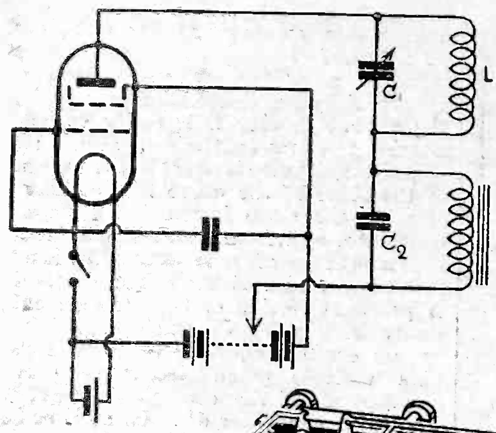


Fig. 3.—A practical circuit of a complete dynatron oscillator which is described in the text.



test repeated; if the valve stops oscillating with a smaller bias the coil is inferior because it gives a lower-impedance circuit, whereas if it continues to oscillate when a higher bias is used, you have a better coil.

Measuring Wavelength Range

The wavelength range of an unknown coil can also be measured; the coil is connected in circuit and an oscillating receiver operating on the approximate wavelength is tuned until a beat note is obtained with the dynatron when C_3 is at minimum capacity; the calibration of the receiver gives the wavelength to which it is tuned and the upper limit of the unknown coil can be obtained in the same way. Ganged-coil sets can also be checked by tuning each coil in turn to a certain wavelength and noting any discrepancy in the capacity of C_3. Small fixed condensers can be connected in parallel with C_3, using a good coil for L_1, and after retuning C_3 to give the initial wavelength, the grid bias is increased to the non-oscillating point; the bias with and without the fixed condenser then gives a measure of its efficiency compared with the air condenser. As in the case of coils the matching of a ganged condenser unit also can be checked.

Audible-frequency Oscillations

The dynatron will oscillate at audible frequencies if a high inductance coil, such as an L.F. choke or transformer primary, is used at L_2 and tuned by a fixed condenser of between .001 and .01 mfd. capacity, depending on the pitch of the note required. If a low-frequency circuit L_2C_2 of this kind is connected in series with a H.F. circuit L_1C_1, as shown in Fig. 4, the dynatron will oscillate at both high and low frequencies and radiate a modulated wave that can be picked up on a non-oscillating receiver and used, for example, instead of a broadcast transmission to trim a ganged condenser unit. The dynatron is particularly useful for this type of work and for the measurements and comparisons outlined above.

A Dynatron Wavemeter

In addition, it makes a good wavemeter because, as long as the total space current drawn by the valve (measured by a milliammeter inserted at X in Fig. 3) is kept constant, the wavelength of the circuit is very little affected by changes in the plate and screen-grid potentials, provided they vary in the same ratio as they would if due to the running-down of the H.T. battery. Furthermore, the circuit gives strong harmonics with a good valve so that although it cannot be made to perform very satisfactorily below about 50 metres, a wavemeter for use with short-wave receivers can be made by covering the band from, say, 55 to 120 metres (C_3 .0002 mfd., L_1, about 30 turns on a two-inch former),

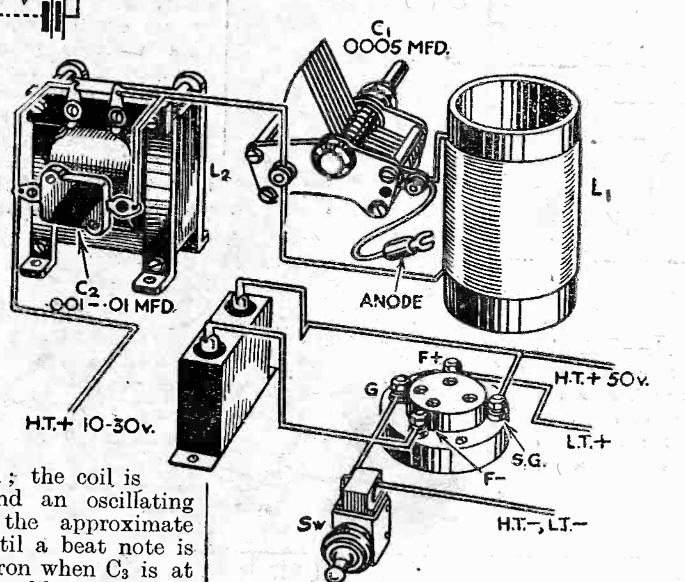


Fig. 4.—By using the circuit shown above, where an iron-core choke is connected in series with a tuned H.F. circuit, the oscillator will oscillate at both high and low frequencies.

and using the second harmonic to cover from 22.5 to 60 metres, and the fourth from 11.25 to 30 metres. A wavemeter of this kind must be very rigidly constructed, especially as regards the coil and condenser, and must have a metal panel to remove hand-capacity effects. A milliammeter must be kept permanently in circuit at X, and the total space current always adjusted to the value at which the meter was calibrated; it will generally be from 2.5 to 5 m/a and should, of course, be kept as low as possible in order to prolong the life of the valve and battery.

TOPICAL TECHNICALITIES

Wattage Dissipation

When current is passed through any circuit or component having resistance, a voltage drop occurs across that circuit. In other words, a certain amount of voltage is "lost," or wasted. It is one of the laws of science that nothing can be "created" or "destroyed," but, as the voltage-drop across the resistance multiplied by the current flowing represents "power," it would appear that in the case under consideration, some power must inevitably be lost or destroyed. This is not actually the case, however, since the electrical power is simply converted into energy of another kind—heat. This explains why all resistances show a certain rise in temperature after they have been passing current for any length of time. As a matter of fact, the temperature commences to rise as soon as a voltage is applied between the ends of the component, or circuit including it.

It will be evident that the energy which is in the form of heat is "wasted" or "dissipated," and it is this which gives rise to the expression "wattage dissipation," due to the fact that the power (in watts, found by multiplying the voltage across the resistance by the current) is changed into heat, and is then "dissipated."

Knowledge of these facts is essential when choosing resistances and other components for use in wireless circuits, because if these are not capable of dissipating sufficient energy they will heat up unduly, and damage will result.

FILTERS AND FUSES

Although at first sight there appears to be no connection between filters and fuses, it can be seen on closer consideration that fuses should be fitted to mains filters. The type of filter referred to is shown in Fig. 1, and is for reducing hum and interference. This filter should be placed as close as possible to the point at which the mains enter the house if the trouble is to be reduced to a minimum. From Fig. 1 it can be seen that the condensers C_1 and C_2 are connected directly across the mains, the centre point being earthed. This is a very effective method of reducing the interference due to the mains, and it is essential that fuses of low current-carrying capacity should be connected in the circuit as shown.

House Mains Fuses

At this point the practical wireless man will be thinking of the main fuses in the house. If the main fuses are relied upon, any trouble which does occur to either of the condensers will cause the house fuses to blow. If extra fuses of low current-carrying capacity are in circuit these will blow first, thus eliminating the possibility of the house being in darkness should any breakdown occur. These fuses will have no effect on the filters which are required to by-pass the high frequency currents and to steady the voltage in the case of direct current mains. Any light fuse rated at .5 amp or so may be fitted. We shall thus have a fully-protected filter.

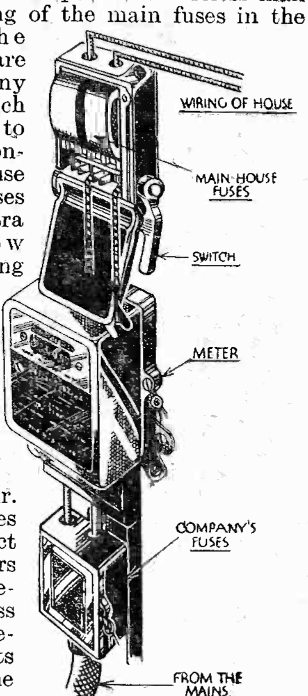


Fig. 2.

The wireless engineer always tries to avoid fuses where possible, and although this is quite all right on some circuits it is advisable to be on the safe side when using the mains. The "heavy" electrical engineer does not leave things to chance, as can be seen from considering the usual house switch and fuses; this is shown in Fig. 2, which should be of interest to readers. First of all comes the company's main fuses, the meter, the main switch, then the main fuses to the house wiring. It can be seen from this that things are not just left to chance.

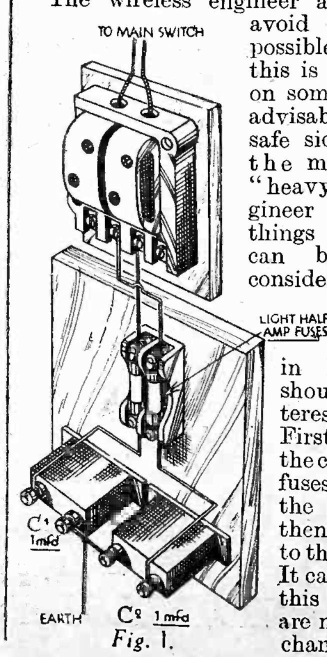


Fig. 1.

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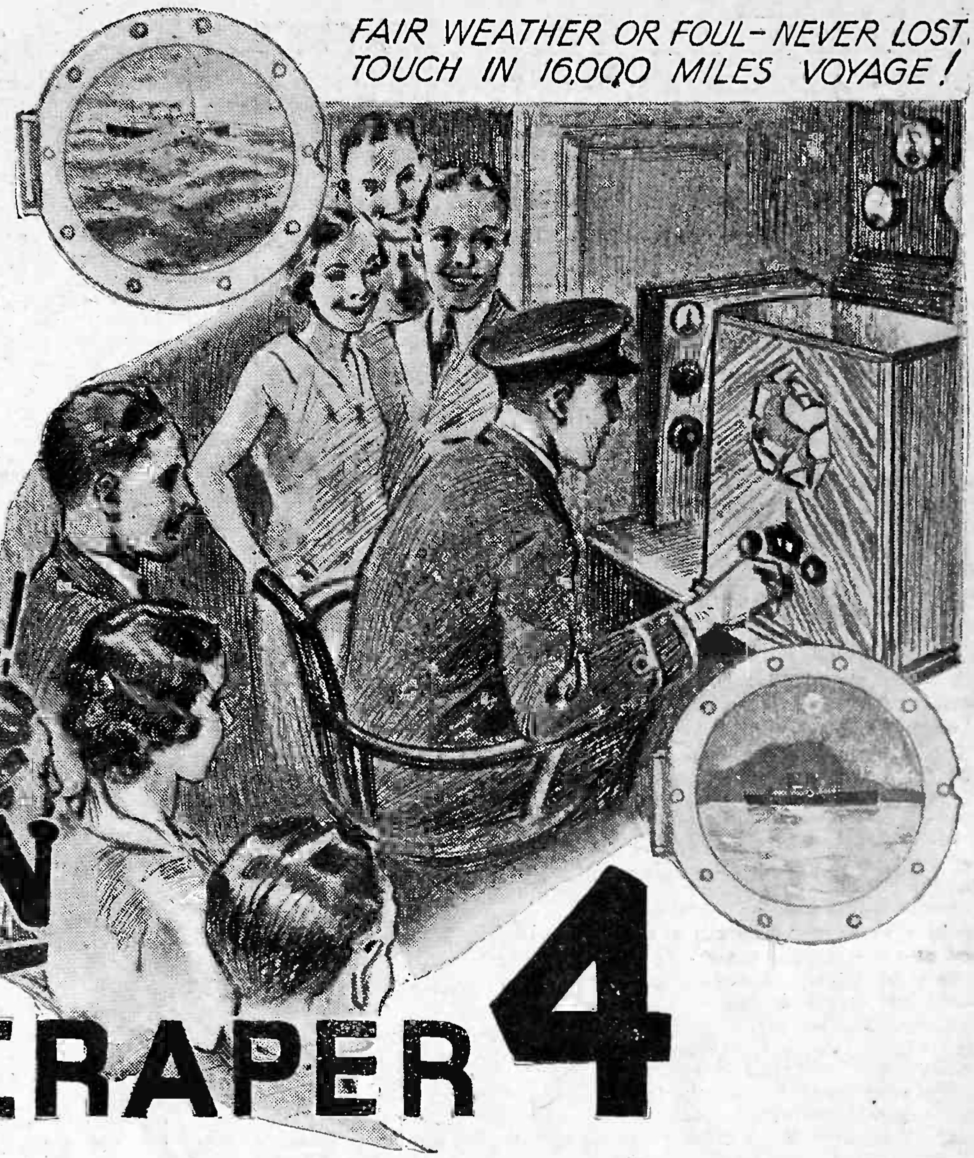

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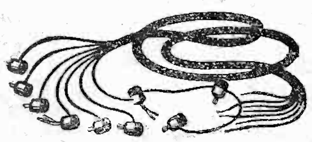

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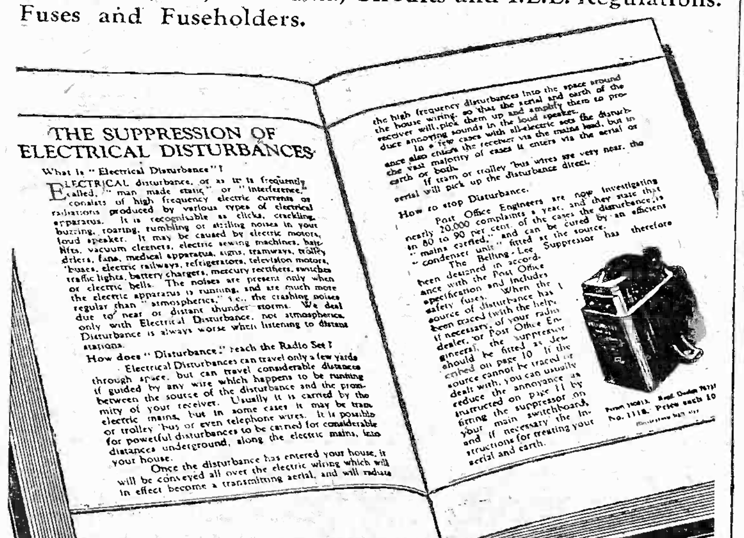

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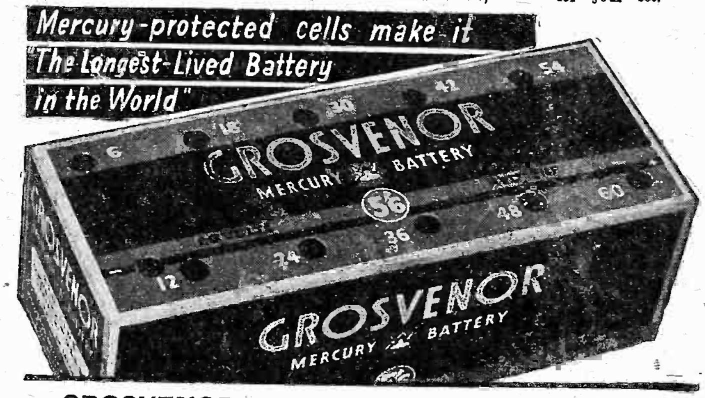

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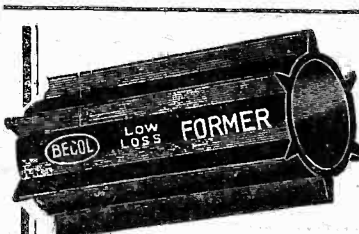

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DISTORTION IN AMPLIFIERS

Notes On Its Cause And How It Can Be Overcome.

By E. G. ROWE, B.Sc. (Hons.), A.C.G.I.

THE general aim in the design of all amplifiers is high amplification with the minimum of distortion. The ideal amplifier is one whose output waveform is exactly similar to the input waveform; then there is no distortion. To put this in another way—distortionless amplification is obtained if the amplified current in the output circuit is an enlarged reproduction of the input current for the whole range of frequencies which it is desired to transmit. However, distortion creeps in at every part of the circuit, from the detector to the loud-speaker, and the amount that it is overcome is as much an economic proposition as a technical one. Any dissimilarity between the input and output currents is known as waveform distortion. As is well known, the electrical oscillations in an amplifier have a complex waveform. This waveform, no matter how complicated it is, may be broken up, or analysed, into a number of smooth curves called sine waves. These represent pure tones, such as one would get from an organ pipe or a tuning fork. To understand waveform distortion it is necessary to remember this.

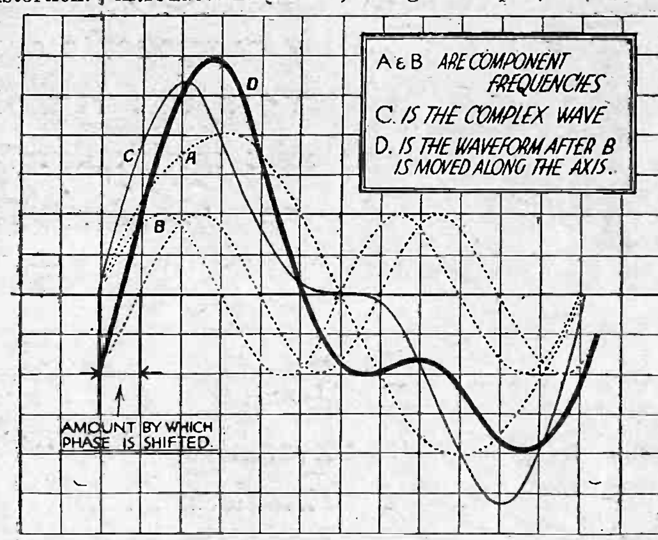


Fig. 1.—A graph illustrating the alteration in shape of signal waveforms.

Waveform Distortion

We will consider waveform distortion under three heads. The first is *phase shift* which is introduced by the characteristics of the circuit. It is of great importance in long telephone lines, but causes very little trouble in audio frequency amplifiers because fortunately the ear is a very accommodating organ and is very insensitive to phase shift, taking note of the intensity and frequency of the components of the complex wave rather than of the wave itself.

The way in which phase shift alters the shape of the received signal is illustrated in Fig. 1. We have taken two frequencies A and B and combined them to form the complex waveform C. Then B is moved along the time axis, that is, its phase is altered, and the combined wave then becomes as shown at D.

The second form is known as *frequency distortion*. This is caused through voltage variations applied to the grid at various frequencies not being equally amplified. Thus, 1 volt at 50 cycles/sec. may only be amplified one-tenth as much as 1 volt at 3,000 cycles/sec. This is due chiefly to the variation of the circuit impedances with frequency. For example, a 60 henry choke has an impedance of 1,880 ohms at 50 cycles/sec., while at 5,000 cycles/sec. its impedance has become 190,000 ohms and it thus offers 100 times the impedance to a 5,000 cycle note than it would to a 50 cycle note. Similarly, a 0.0005 mfd. condenser has an impedance of 0.16 ohms at 50 cycles and 0.0016 ohms at 5,000 cycles. This is the reason that resistance-coupled amplifiers are considered to be much freer from distortion because a properly designed resistance has a constant value regardless of the frequency—this applies to audio frequency amplifiers. However, transformers and condensers can be so chosen that for the operating range of frequencies the total impedance is not unduly affected by the frequency.

Amplitude Distortion

The third type of distortion is known as *amplitude distortion* in which the amplitude of the output variations is not linearly related to the amplitude of the input variations. By " linear relation " we mean that if the instantaneous input and output currents were plotted against each other the graph would be a straight line, showing that the output varied as the input. This is shown in Fig. 2. It can be shown mathematically that this non-linear relationship introduces harmonics, or high multiples, of all the frequencies present in the input voltage, together with new components having frequencies equal to the sum and difference of each pair of frequencies in the input. Thus, if there are frequencies f_1, f_2, f_3 in the input, the harmonics of these would have frequencies of $2f_1$, $2f_2$, $2f_3$; $3f_1$, $3f_2$, $3f_3$ and so on, while the sum and difference frequencies would be f_1+f_2, f_1-f_2, f_2+f_2, f_2-f_3, and so on. Sum and difference tones cause the more annoyance in an audio frequency amplifier because they are generally discordant. The unpleasant fuzziness often met with in amplifier, particularly in orchestral passages, is generally due to the sum and difference frequencies. Amplitude distortion may be caused by the curvature of the valve characteristics or by the bad characteristic of the output device. To overcome the trouble in straight amplifiers the operation must take place on the straight part of the valve characteristic, and also the amplitude of the plate and grid potentials should be kept comparatively small so that the amplification and the anode resistance may remain approximately constant over the whole cycle of operations. Class B amplifiers work over a larger part of the characteristic, but distortion is overcome by using either two valves or a double valve in one glass envelope, one valve operating on each side of the time axis.

With low-frequency amplifiers both frequency and amplitude distortion are serious, but the latter is the worse; with high-frequency amplifiers it is frequency distortion that causes the most trouble.

The distortion in high-frequency amplifiers, while generally the same as in low-frequency ones, has several distinctive features. Frequency distortion, as before stated, is the more serious because any modulation of the high-frequency signal is after rectified. However, it must be recognised that as radio frequency amplifiers are generally tuned it is only frequencies in the neighbourhood of the resonant frequency that pass through the amplifier—thus a common form of high-frequency distortion occurs when the difference in frequency between two high-frequency carrier waves approaches the resonant frequency. Then again, a deeply modulated carrier wave, which acts on the amplifier at the same time as a second carrier, to which the amplifier is tuned, is being received, is liable to set up what is known as crosstalk.

In conclusion, we may sum up distortion as consisting of two principal kinds:—

(1) That set up when currents of different frequencies are not amplified by equal amounts. This is overcome by good design.

(2) That due to the amplification not being independent of the input voltage. To ensure freedom from this fault the working characteristic must be linear over the operating range of voltage, which demands the correct choice of valves and a high external output impedance.

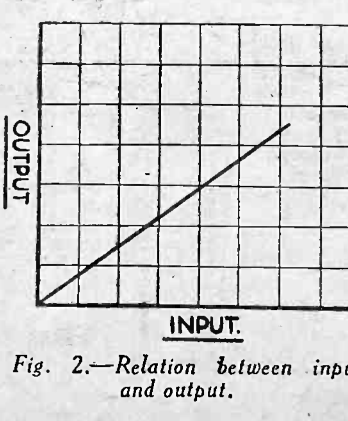
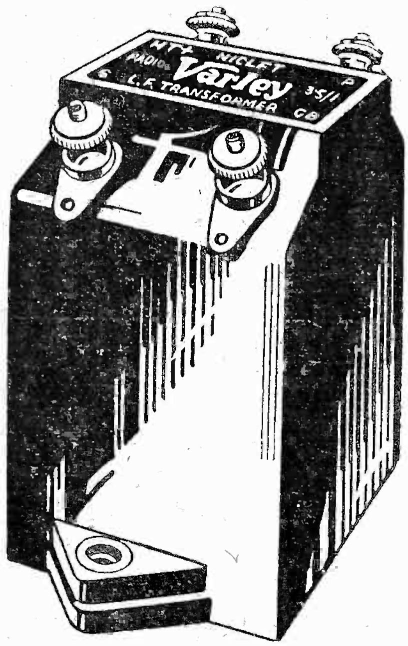


Fig. 2.—Relation between input and output.

Poznan's New Transmitter

BETTER signals from Poznan (Poland) are now being picked up on 345.2 m., as since the beginning of February the new 17-kilowatt transmitter has been gradually taking over the broadcasts. According to a Polish paper, Poznan will be endowed later with more powerful plant; in fact, it is possible that when the system has been reorganised a 50-kilowatt transmitter may be installed in the neighbourhood of that city.

"LEADER THREE"



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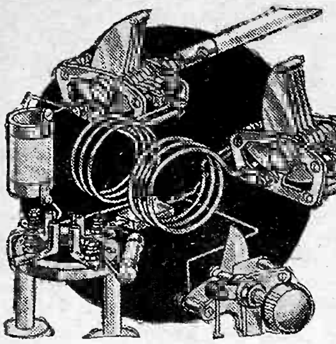


Short Wave Section

SPECIAL AERIAL SYSTEMS FOR SHORT-WAVE RECEPTION.

The Short-Wave Enthusiast Will Find Ample Scope for Practical Experiments in the Various Types of Aerials Described in This Article By ALF. W. MANN

THERE are various types of short-wave aerials, the majority of which are of simple construction, and which may be used in conjunction with any type of short-wave receiver. As a rule, the magnitude of aerial experiments undertaken by the average amateur is governed by the amount of space in which to erect alternative aerials and the particular site of his house.

It is, of course, well known that almost any aerial, either long or short, will do for short-wave reception. It does not follow, however, that the results obtained will do justice to the capabilities of even the most ordinary receiver; therefore, if at all possible, the construction and erection of a special aerial suitable for short-wave reception should be considered.

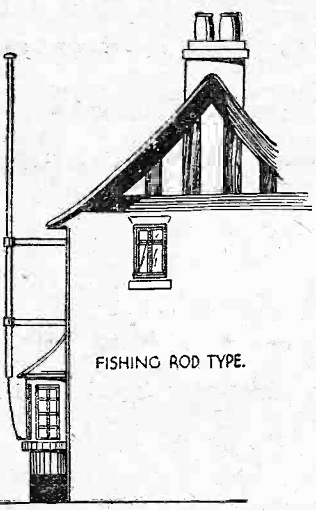


Fig. 1.—A "fishing rod" type of vertical aerial.

In placing the suggestions outlined in this article before readers, the writer has taken into account the circumstances under which the majority of short-wave enthusiasts carry out their DX and experimental work, and has confined his suggestions to those where unlimited space is not the ruling factor. Fig. 5 is, of course, given as an interesting example only, as very few enthusiasts will be fortunate enough to have the amount of open space at their command which is necessary to erect the type of aerial shown.

In many instances, aerials consisting of a length of insulated wire laid behind a picture rail are in use. Whilst no doubt moderately satisfactory for broadcast reception, such an aerial leaves much to be desired so far as short-wave reception is concerned.

Aerials Under the Roof

If the experimenter lives in a private house, and wishes to use the short-wave receiver at will leaving the broadcast receiver coupled to its own aerial, the possibilities of an inside aerial zigzagged between the rafters under the roof should certainly be considered. The writer uses an aerial of this type strung from corner to corner with the down-lead from the far end. The total length is 65ft. of insulated aerial wire, and the results obtained are quite satisfactory.

The flat dweller in the cities and large towns has a difficult problem to solve, especially if his flat happens to be about half-way between the top and bottom of the block, for it is certain that those above him will have availed themselves of the roof facilities, whilst those below will take advantage of the back space available at ground level.

A commercial idea known as the "Fishing Rod Aerial," shown in Fig. 1, provides a solution to this problem, as it is mounted in a vertical position by means of two wall brackets. Whilst specially applicable to the circumstances outlined above, the idea is commendable to anyone who requires an additional aerial, or, for instance, an aerial for broadcast reception which may be erected with the minimum of trouble.

Vertical Aerials

As vertical aerials are under consideration, details, as given in Fig. 2, may be of interest. As the sketch is self-explanatory, further comment is unnecessary. It should be noted, however, that providing it is possible to use supporting brackets which will allow the aerial to hang at least 2ft. from the wall, there is no reason why this type of aerial should not be used when there is sufficient height available.

In Fig. 3 we have a variation of the above idea, and, whilst eminently suitable under certain circumstances, the possibilities of swinging signals, due to the swaying of the broadcast aerial in the wind, should not be overlooked, as under these circumstances tuning in and holding signals even on a stable and trouble-free receiver is apt to be difficult.

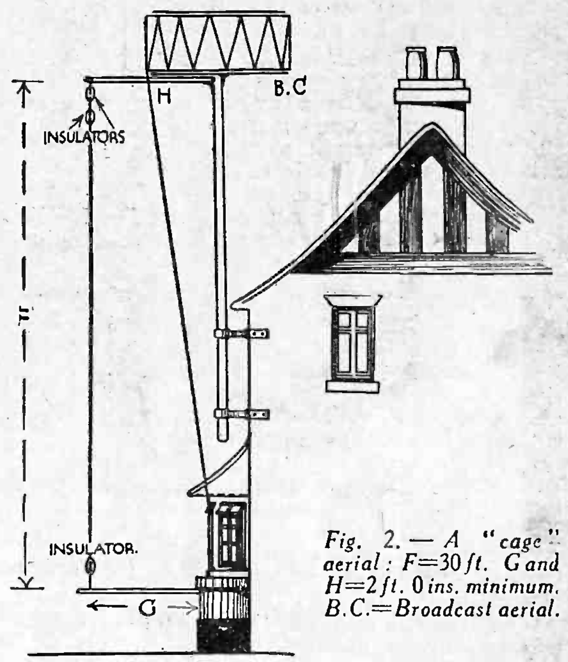


Fig. 2.—A "cage" aerial: F=30 ft. G and H=2 ft. 0 ins. minimum. B.C.=Broadcast aerial.

A Divided Aerial

The details concerning the arrangement shown in Fig. 4 were forwarded to the

(Continued on next page)

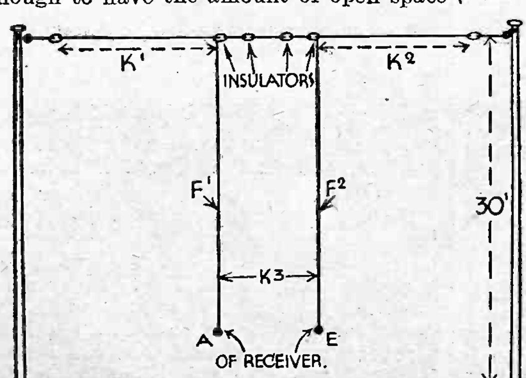


Fig. 4.—A divided aerial: K1 and K2 are equal in length half the wavelength. K3 = 4½ inches.

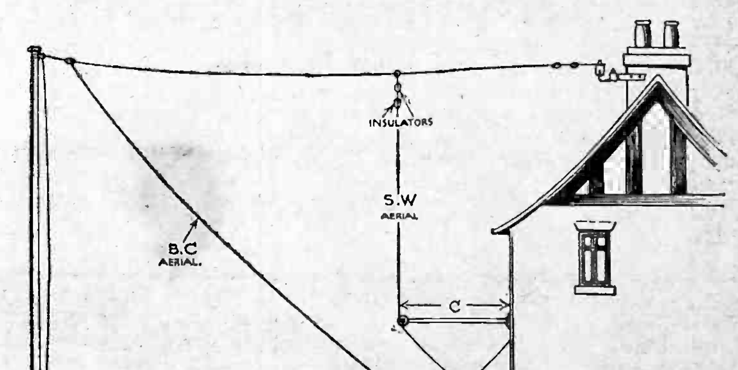


Fig. 3.—A dual aerial, A=S.W. aerial: lead-in at top right-hand side of window. B=B.C. aerial: lead-in at bottom left-hand side of window. C=2 ft. minimum.

AERIAL SYSTEMS FOR S.W. RECEPTION

(Continued from previous page)

writer by a New Zealand enthusiast who is highly satisfied with the results obtainable. The fundamental principle is that each flat top is half a wave length, *i.e.*, if the listener wishes to receive say, for example, on a wavelength of 25 metres, the individual flat tops must be 12½ metres long. Unfortunately, details as to whether the feeders F^1—F^2 are tuned in order to bring each half in resonance is not stated. The writer has not sufficient space available to try out the idea, but it may have an appeal to listeners abroad who hear one or more of the British Empire Transmitters regularly.

As previously stated, the transposed aerial arrangement shown at Fig. 5 is included as a matter of interest. The advantage of this type is, that whilst it is not a complete eliminator of outside interference, such as that caused by electric signs, lifts, car-ignition, and other systems, it is effective in cutting down the interference to such an extent that the ratio of signal strength to noise is in favour of the former.

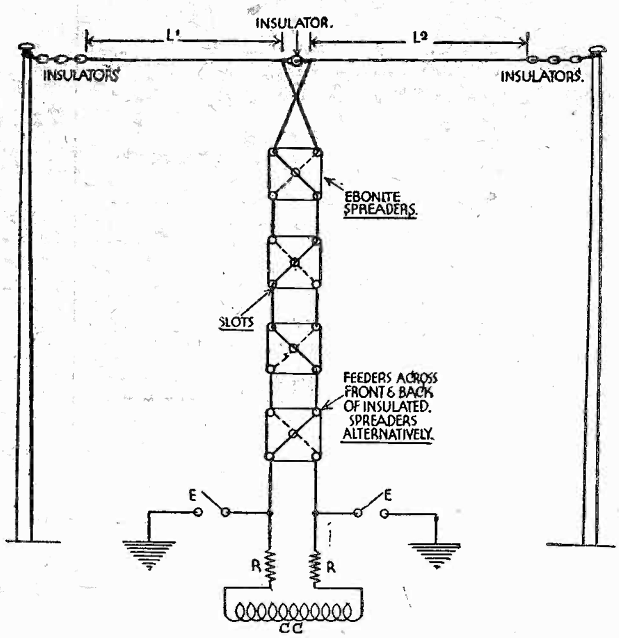


Fig. 5.—Transposed or horizontal doublet aerial. E= earthing switches. CC=coupling coil. RR=600 ohm resistances. L^1, L^2=40 ft. acrials.

There is no doubt that about 80 per cent. of such interference is picked up directly by the lead-in and earthing systems, as the interference is near the ground. Taking these facts into consideration, it is quite clear that the flat top of the aerial system will pick up less interference, as it is farthest from the source.

It should be understood, however, that whilst both signal and interference are picked up by this type of aerial, the voltages set up in each feeder is due to the transposition, 180 degrees out of phase with the other. These voltages, when applied across the tuning coil, partially cancel out the interference.

This type of aerial system is favoured by many listeners in the Antipodes. A considerable amount of open space is required, however, but providing sufficient height is available, some interesting results may be obtained by erecting the transposed feeders without the flat top arrangement. The usual earthing system is not used.

MAKING SURE OF PERFECT RECEPTION

How the B.B.C. Looks After Listeners.

By HAROLD A. ALBERT.

A CRITICISM often levelled at the B.B.C. is that although perfect transmission is assured, the reception side of radio is generally left to take care of itself. In solid fact, this accusation is unjust. Under the control of the Chief Engineer, a department at Broadcasting House specializes in looking after the technical troubles of listeners. Known as Technical Correspondence, its job is to answer the complaints of amateurs, wireless traders, old ladies and enthusiastic schoolboys alike.

Complaints about oscillation and interference, sorrowful questions of the "what's wrong with my set?" type, and replies to criticisms of the quality of broadcast transmissions—all come within its scope, while the records of the department form an almost unique guide to the gradual march towards perfect radio reception.

Oscillation Complaints

At one time, for instance, complaints of oscillation preponderated. Programme time was seriously jeopardized by S O S messages from local stations, asking residents of various streets to look to their sets lest they be causing interference. A huge map at broadcasting headquarters, studded with pins, enabled the engineers to see how the tide of oscillation complaints ebbed and flowed in different districts. And grounds for suspicion arose that some listeners grumbled of oscillation solely in order to hear the name of their street read into the microphone!

The advent of the screen-grid valve with its higher magnification, and the greater signal strength of modern transmitters, ended all that. Oscillation complaints are now almost nil. Listeners have learned how to control the reaction of their sets. The powers of Broadcasting House, by their tactful suggestions through the mike, and the admirable pamphlets prepared through the Technical Correspondence Section, have almost entirely eliminated an etherial curse.

The B.B.C.'s Questionnaire

The few complaints there are nowadays are dealt with by sending in reply a questionnaire. Does this seem red tape? In reality, the question paper is so cleverly constructed and arranged that after reading it the listener himself is generally able to locate the offender and put matters right. If, by any chance, he does fail, the Post Office Engineers—working hand-in-hand with Broadcasting House—are set on the trail, and their much-discussed blue van with its direction-finding apparatus patrols the streets and tracks down the oscillator.

Other forms of interference are handled in similar fashion. Are you troubled by wireless telegraphy or morse? The men in charge of the Technical Correspondence will send you gratis full information and advice on improving the selectivity of your set. Should this prove useless, a visiting Post Office engineer will do his best to put the matter right. Is an amateur station working next door, and spoiling your entertainment? The G.P.O. will fix it.

Electrical Interference

Electrical interference, that other bugbear, is also rectified whenever possible. If a listener is getting noises in his set from electric signs, X-ray apparatus in a neighbouring hospital, or a dynamo in an adjacent cinema, he has merely to tell the B.B.C., and assure the engineers of the genuineness of his complaint by taking the trouble to fill in their questionnaire, and the G.P.O. send out experts with apparatus which will probably cure the trouble.

Perhaps something can be done to your set, or to the cause of interference itself.

Difficult Cases

Only in those cases in which trams or electric railways are concerned do the engineers find themselves "up against it." Interference from electric trains is on the wane now that overhead wires are giving way to the third rail system, but trams and trolley 'buses still give trouble. In frosty or rainy weather, or perhaps after a sandstorm has taken place on the front, they create such havoc with the wireless reception that sometimes little can be done to ease matters. There is nothing for it but to wait until the trouble has blown over—although improving the selectivity of one's set or altering the position of the aerial will occasionally do the trick.

Heterodyne Interference

Heterodyne troubles—that is, interference between stations due to the shortage of wavelengths—are another matter. They can only be dealt with internationally. The B.B.C. representatives at international meetings are kept fully aware of listeners' difficulties in this regard. The B.B.C., it will be seen, really are as keen on perfect reception of their transmissions as they are on the perfection of the transmissions themselves.

Complaints of interference by no means account for all the technical correspondence. There are also hundreds of letters from listeners who want to get the best out of their sets, or who are suffering from mysterious breakdowns for which they are unable to account. Every letter is answered and the B.B.C. prove themselves again, as always, willing to help so far as the reception of their own service is concerned. Or a technically-minded man may write to say that the reverberation period of a certain transmission on such-and-such a night was so-and-so, whereas it is usually something-or-other, and that he found it better or worse.

Such letters supply a great deal of information concerning listeners' opinions on the quality of the transmissions which otherwise would be lacking. Many a listener has been advised from headquarters as to the best place to stand his loudspeaker for good results, and the articles chosen for the Technical Section of the B.B.C. year books are based largely on the type of inquiry made by listeners!

REVIEWS OF LATEST RECEIVERS

Tests of Standard Receivers On Our Aerial.

"HIS MASTER'S VOICE" "SUPERHET FOURFORTY" (A.C.)

THIS latest production of The Gramophone Company is somewhat of an experiment in one direction, although there is nothing of doubtful efficiency in its make-up and performance. The experiment is in regard to the price—12 guineas—which undoubtedly sounds far too low for a high-grade instrument having four valves and bearing the hall-mark of perfection bestowed by the name "H.M.V." As a matter of fact, the makers have a very good and sound reason for offering such amazing value. It is their intention that an instrument capable of giving the best possible reproduction should be within the reach of every household.

It need scarcely be pointed out that this latest set, which has only just become available to the public, upholds the high standards which have always been set by "H.M.V." products. It is, as the name suggests, a four-valve (plus rectifier) superheterodyne receiver, and can be obtained for operation from all 50-cycle A.C. mains supplies.

The Cabinet and Controls

This set is beautiful to look upon besides being pleasing to the ear. It is housed in a remarkably attractive modern—but not fantastic—walnut cabinet which has been specially designed and made in the "H.M.V." factories to eliminate all resonance and "boom." The front is attractively veneered and has a square speaker opening which is in very good taste. There are four controls symmetrically arranged about a rectangular tuning-scale opening. The scale is illuminated when the set is switched on and is marked off in wavelengths from 200 to 550 metres and from 900 to 2,000 metres; it is traversed by a vertical pointer. At first the makers had in mind the fitting of a station-calibrated tuning scale, but this was wisely deferred for the moment, due to the fact that there will probably be a number of minor wavelength changes before the Lucerne Plan gets quite "into its stride." In order that users may have no difficulty in finding the setting for any desired station, however, a carefully prepared stout card is supplied to fit into a slide beneath the cabinet; the card is in the form of a chart showing the wavelengths of all the popular European stations, whilst two scales also printed on the card show the positions of long- and medium-wave stations on the tuning scale. The makers advise us that they propose to issue a station-calibrated scale to fit over the existing one when, and if, the wavelengths of European stations become definitely and finally settled. This scale will be supplied at very low cost and will be in such a form that it can be fitted almost instantaneously.

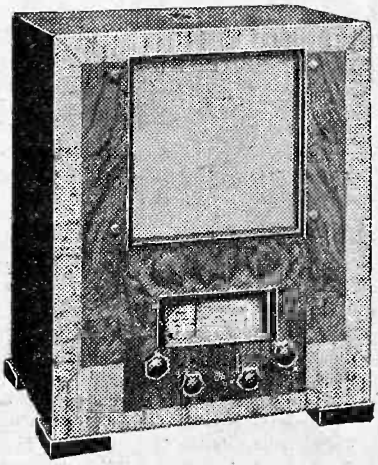
Of the four controls mentioned, one is, of course, for tuning, a second (that on the extreme right) can be rotated into four positions to give "Medium Waves," "Long Waves," "Gramophone Pick-up" and "Off." The knob on the left is for volume control, and the one next to it is for the purpose of varying the tone of reproduction to suit all "taste" and every type of transmission. All the controls are very accessible and work in a particularly smooth and effective manner, the volume and tone controls being "graded" in such a way as to produce a uniform change over the whole of their movement.

A Modern Circuit

The circuit of the "Superhet Fourforty" is on very efficient and up-to-date lines, and comprises a non-radiating screen-grid frequency-changing valve having cathode coupling, a 125 k/c variable-mu intermediate-frequency amplifier, a power-grid second detector, and power pentode output valve fed by a special L.F. transformer and giving an undistorted output of $1\frac{1}{2}$ watts. The rectifier for H.T. supply is a full-wave with an output of 325 volts at 120 milliamps, which is obviously a very generous one for a four-valve set.

To ensure high-quality reproduction a new type of "H.M.V." energized moving-coil loud-speaker is employed, and this is mounted on an open baffle so that there is no wooden fret to act as an obstruction to the sound waves.

Other special features of the receiver under review are: the fitting of an effective whistle suppressor; the circuit is so designed that there is no sudden "blast" when tuning past a powerful station; the set can, if desired, be operated in any room without the necessity for an aerial and earth; reproduction is not marred by the appearance of images. These are just a few of the points which are very apparent and which are worthy of particular attention.



The new "His Master's Voice" "Superhet Fourforty" costs only 12 guineas for the A.C. model. It has a cabinet of finely figured walnut, and the tuning arrangements are extremely simple.

Tested Without Aerial

Our first test of the "Superhet Fourforty" was under rather unfavourable conditions, since the set was used without either aerial or earth some twelve miles from Brookmans Park. Despite such a handicap we found no difficulty whatever in bringing in no less than twenty stations at honest "programme" strength. The question of selectivity simply did not exist, and no transmission occupied more than a fraction of a division on the tuning scale. Reproduction was what we expected from an "H.M.V." instrument—as near to perfection as possible under present conditions (and that is really saying a lot). The tone control was found particularly useful in obtaining the maximum pleasure from listening to foreign stations whose transmissions are not always of such high quality as those of our own B.B.C. A commendable feature of the tone control was that it did not affect volume to a very marked degree, as is usually the case, and it functioned remarkably well in every way. The volume control was equally useful and effective; it had to be made good use of when receiving a number of stations in order to prevent overloading, so the reader may judge what a high degree of amplification is afforded.

"Crampless" Controls

A point which should be stressed in regard to the volume control is that it did not appear to have the very slightest effect upon the quality, with a result that volume could be turned down to almost inaudibility without music sounding "thin" and lacking in "body." A feature of all the control knobs which is well worthy of mention is that they are "crampless," having been designed in conjunction with anatomical experts—this is surely a sign of the times and a point of importance. It should be mentioned in respect to the tuning scale that it was found to be really accurate.

After the rather unfair preliminary test we tried the set on a moderately good outside aerial and connected an earth lead. Results were truly astounding, and there was apparently no limit to the number of stations which could not only be received, but actually enjoyed for their entertainment value. In every case the quality was all that could be desired, and we could find no item upon which to criticise adversely.

Every reader who intends to buy an up-to-date set of marvellous quality and at an almost unheard-of price should not fail to consider the merits of the "H.M.V." "Superhet Fourforty." The set can be obtained for D.C. operation at 13 guineas, or as a complete and attractive radio-gramophone in console cabinet at 20 guineas (A.C.) or 21 guineas (D.C.).

GRID DECOUPLING—

A Number of Lesser-known Points in Respect of L.F. Amplifiers are Dealt With in This Article

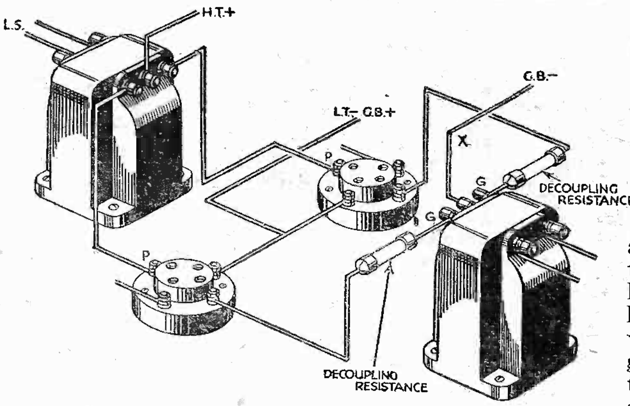


Fig. 1.—Showing how grid decoupling resistances are connected in the case of a battery-operated push-pull amplifier.

THE general subject of grid bias, automatic and otherwise, has been dealt with in these pages on more than one previous occasion, so it is not proposed to repeat any information which has been given before, but rather to touch upon points of a rather more specialized kind. The following notes have been prompted very largely by readers' queries and by incidents which have arisen in carrying out experimental work, and in designing various forms of L.F. amplifiers. My remarks may appear somewhat disjointed, because I shall attempt to cover as much ground as possible in reasonably few words. Moreover, I shall try to deal with all those points which have been known to puzzle readers whilst designing amplifiers and receivers for their own use.

Grid bias and grid decoupling are not always associated one with the other, but in most cases they are so closely bound up that they should be considered jointly; this is especially true in the case of mains receivers where two or more L.F. amplifying stages are employed. In order to make this point quite clear, it might be as well to commence by considering a battery-operated amplifier having a push-pull output stage something like that shown in Fig. 1. In this case a centre-tapped input transformer is employed and the negative G.B. connection is made to the centre tap of the secondary winding. It is known that the two valves in push-pull should be as nearly identical as possible in order to ensure correct "balance"; if they are not alike there will be a loss in amplification and a danger of parasitic oscillation. In practice it is almost impossible to obtain two valves with exactly similar characteristics, except by ordering two matched ones from the makers and paying a slight extra charge. Even when this is done the valves deteriorate at different rates, so that, in time, the circuit becomes "unbalanced." But the effects of this can nearly always be overcome satisfactorily by inserting a decoupling resistance in each grid lead, as shown in Fig. 1. The value of the resistances can generally lie anywhere between 50,000 and 100,000 ohms and is not critical.

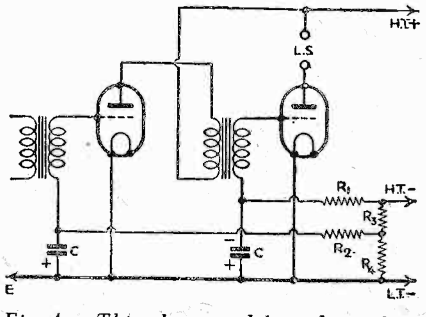


Fig. 4.—This shows grid-bias decoupling arrangements when two battery-operated L.F. valves are automatically biased.

Output Valves in Parallel

A precisely similar thing applies when two valves are connected in parallel to handle a greater output, and in this case grid decoupling is generally even more important. Provided that the valves are of similar types, however, excellent results can nearly always be obtained by including a fixed resistance in the grid circuit of each; this is shown in Fig. 2. It might be argued that there is no point in connecting two output valves in parallel these days because a greater output can be obtained by using Class B. This is not quite true, though, because it is often wished to make use of two valves which are on hand without having to buy special transformers and a new Class B valve. Besides, parallel working is very satisfactory indeed when the output stage is preceded by a high-amplification L.F. valve and an efficient detector. Particularly is this true when the set is operated from an eliminator which is unsuitable for Class B purposes.

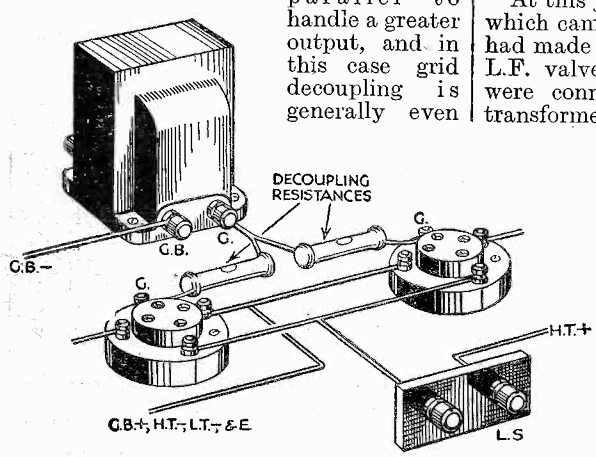


Fig. 2.—Grid decoupling resistances are very desirable when two valves are wired in parallel.

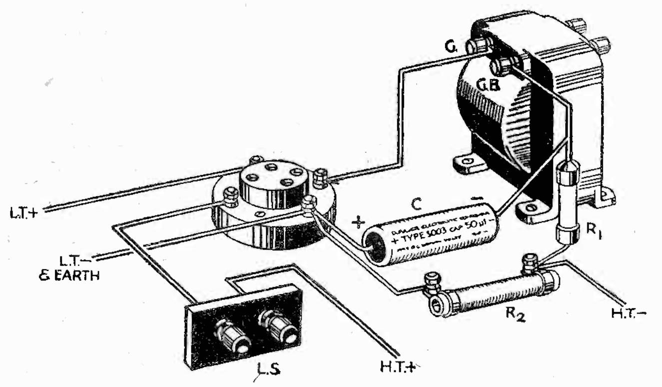


Fig. 3.—G.B. and decoupling resistances in a battery-operated output stage. R.1 is for decoupling and works in conjunction with the electrolytic condenser C.

Q.P.-P. and Class B

An arrangement similar to that shown in Fig. 1 is useful in the case of Q.P.-P. (which, incidentally, looks like becoming very popular again in view of the new valves which have just been produced), but it is equally satisfactory, and rather less expensive, to employ a single decoupling resistance only, this being included in the G.B. negative lead at the point marked X. The resistance in this case should generally have a value between 100,000 ohms and 150,000 ohms.

At this juncture I might refer to a query which came my way recently. An amateur had made up a Class B amplifier using two L.F. valves of low impedance, and these were connected after a correct Class B transformer. The arrangement should have functioned reasonably well, but it was found that it distorted terribly—why? Well, this particular constructor was well aware of the advisability of decoupling grid circuits, and he had inserted resistances in the grid leads of the two valves. In other words, he had done what has been advised above, and yet he was wrong. The explanation is that valves connected in Class B pass a comparatively high and widely-fluctuating grid current when functioning correctly, but if there is a high resistance in their grid circuits grid-current fluctuations are strongly opposed. This applies with equal force when a proper Class B valve is employed and is an exception to the general rule given above, and which should be followed in every case excepting that of Class B.

Automatic G.B. in Battery Sets

When automatic grid bias is used in a battery set, grid circuit decoupling is often extremely important, for if it is omitted

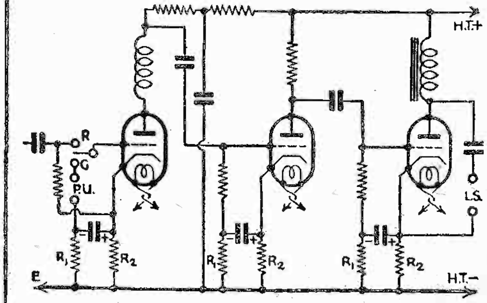


Fig. 6.—Skeleton circuit of the detector and two L.F. stages of a mains receiver where every grid is effectively decoupled.

—AND GRID BIAS

By FRANK PRESTON

all kinds of troubles are likely to be experienced. The method of fitting a decoupling resistance in a set having a single L.F. amplifier is given in Fig. 3, where the resistance in question is marked R.1, and the bias resistance, R.2. It will be seen that the decoupling resistance is inserted between the H.T. negative terminal and the G.B. terminal on the L.F. transformer, and also that a decoupling condenser is connected between the latter terminal and the earth line. The resistance (R.1) may have a value of about 50,000 ohms, whilst the condenser should preferably be of the electrolytic type having a capacity of about 50 mfd. and a working voltage of 20 or so. Notice the polarity of the condenser, and that the positive terminal goes to earth.

When automatic bias is provided for two L.F. valves the arrangement will be something like that shown in Fig. 4. In this case both grid circuits are decoupled, but it would be sufficient to decouple one only in most instances unless automatic bias were also taken for an H.F. valve. At the same time it is slightly "safer"—from the point of view of perfect stability and good quality—to decouple both valves.

Biasing Indirectly-heated Valves

The method of applying automatic grid bias to indirectly-heated mains valves (either A.C. or D.C.) is slightly different from that shown in Figs. 3 and 4, because the bias resistance is included in the cathode lead as shown in Fig. 5. In this case the grid-bias voltage is that developed across R.2, and R.1 serves for decoupling in conjunction with the electrolytic condenser marked C. If decoupling were omitted, R.1 and C would not be used and the G.B. terminal on the L.F. transformer would be connected direct to the earth line. It should be mentioned that grid-bias decoupling is particularly useful in a mains set, not only on the score of L.F. stability, but also because it tends to remove any residual hum, especially if a really large-capacity electrolytic is employed. In practice it is nearly always worth while to use a condenser having a capacity of 100 mfd. or so when such a condenser can be obtained with a sufficiently high working voltage. It should be noticed that the condenser is "returned" direct to the cathode of the valve instead of to earth as one might think would be correct. The point in this is that there should be the least possible resistance to alternating currents between the actual cathode and the G.B. end of the transformer.

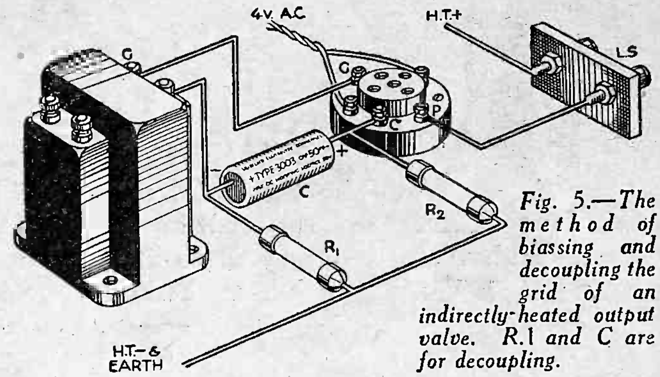


Fig. 5.—The method of biassing and decoupling the grid of an indirectly-heated output valve. R.1 and C are for decoupling.

Decoupling in the Pick-up Circuit

As a further example of G.B. decoupling a circuit is given in Fig. 6 which shows a detector valve (with radio-gram. switch and pick-up connections) followed by two resistance-capacity coupled L.F. stages of which the second feeds into the loud-speaker through a choke-capacity feed system. This is a circuit which would be used for "quality" reproduction when a high-tension voltage of about 300 was available. Automatic grid bias is obtained for every valve by including a suitable resistance (R.2) in the cathode return lead, and every grid circuit is decoupled by means of a second resistance R.1. It is perhaps not very common practice to decouple the pick-up circuit, but it is certainly an excellent idea which makes for perfect stability, and it is one which should be tried when there are signs of slight L.F. oscillation when the pick-up is in use.

When Using a Directly-heated Output Valve

Somewhat different grid-bias arrangements have to be made when an output valve of the directly-heated type is employed in conjunction with others with indirectly-heated cathodes, and one very simple system is illustrated in Fig. 7. Here it is assumed that there is only a single heater winding provided on the mains transformer, and this has to supply the cathodes of both directly- and indirectly-heated valves. It will be seen that the bias is applied to the output valve by means of the usual resistance (R.2) but that this is connected between the centre point of a 30-ohm potentiometer (P) in parallel with the filament and the main H.T. negative lead. A decoupling resistance is again used, and this time it is wired between the lower end of the grid-leak (G.L.) and the earth line, a condenser being connected as before.

An Important Point

Another very important point is illustrated by this circuit, which is that the choke-capacity speaker-feed circuit is returned, not to the earthline, but to the centre point of the potentiometer. As a matter of fact, this applies to all circuits where an automatically-biassed output valve feeds a speaker through a choke-capacity circuit, because if that circuit were returned to H.T. negative there would be a fairly serious loss of signal energy across the bias resistance, which would form a part of the total valve load. This point is very often overlooked, with a result that the maximum output of which the last valve is capable is not realized.

Another way of biassing a directly-heated output valve which is used in conjunction with other valves of the indirectly-heated type is shown in Fig. 8. This is very similar to the battery circuit shown in Fig. 1, and has the disadvantage that the bias resistance passes the total anode current of all the valves in use. The resistance must therefore be of a comparatively high power rating if over-heating is to be avoided. Another objection is that if the anode current of preceding valves is varied over wide limits (such as would be the case when several variable-mu stages were included in the receiver) the bias voltage would be varied at the same time and this might lead to distortion.

Where separate heater windings are provided on the mains transformer there is no difficulty whatever in using a directly-heated output valve with others of the indirectly-heated type. Bias is obtained by inserting a suitable resistance between the centre tap of the winding which feeds the output valve and H.T. negative, as shown in Fig. 9.

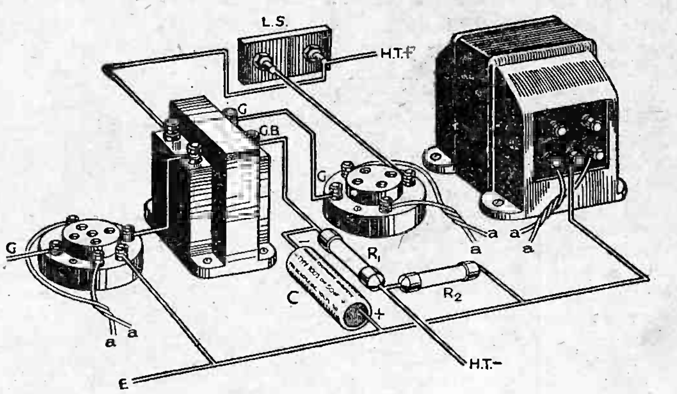


Fig. 8.—A good method of biassing a directly-heated valve which is used along with other indirectly-heated valves and whose cathode (or filament) is heated from the same source.

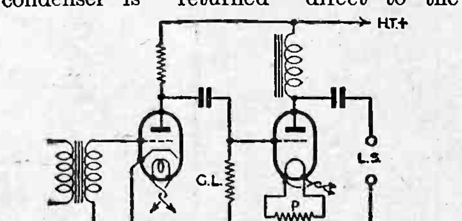


Fig. 7.—This circuit shows the methods of biassing and decoupling a directly-heated output valve in a mains set.

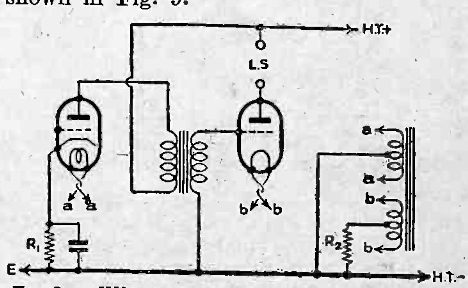


Fig. 9.—When a mains transformer is used which has separate heater windings for the directly-heated and indirectly-heated valves, grid decoupling is generally quite unnecessary, and a circuit such as that shown above can be employed.

A NEW SET AND A NEW POLICY!

THE LEADER T

Once Again We Take the Lead, this Time in Demonstrating that Low Price and Efficiency CAN be Combined in a Home-Constructed Receiver. Our Latest Set, Dealt With Here, is Designed to Cover the New Lucerne Wavelengths, It Costs Only 60/-, is Ultra-Selective, Backed by Our Guarantee, and has Ample Power Output

A MODERN SET FOR 60/-

THE LEADER THREE arrives at a time when the competition of the cheap receiver is giving the home constructor pause! It is an event of the utmost importance to every home constructor, for it marks the introduction of our new policy of designing our receivers on a competitive price basis. It has always been our sincere aim to cater absolutely for our readers, and we have pursued this policy with vigour and enthusiasm. There is no need for us to dwell upon the many examples of reader service which can be placed to the credit of this journal. It will be sufficient to say that scarcely a month has gone by but that we have produced something original, something outstanding, for the many thousands of home constructors who are our enthusiastic supporters. **Nothwithstanding the fact that radio is rather more than twelve years old, it was not until the publication of this journal that home constructors had available a source of information and a free query service designed absolutely for beginner and expert alike. We now take the lead on the price question.**

The Price Problem

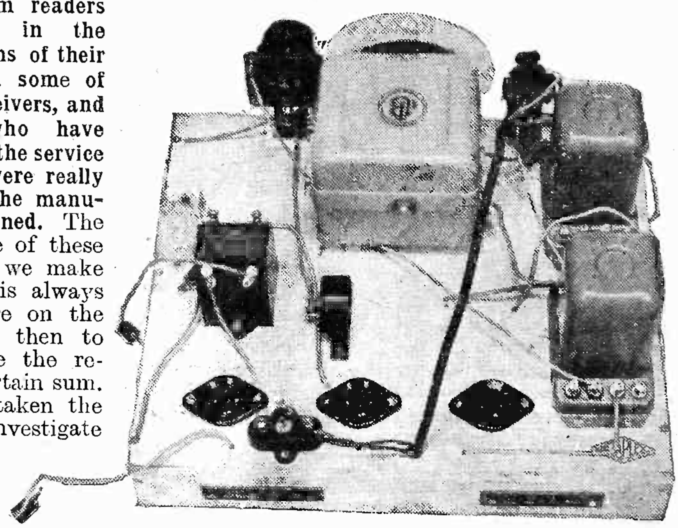
Our policy has been sincere, and we have not hesitated to spend many thousands of pounds to give effect to it. Quite naturally and inevitably we have made considerable inroads into the complete receiver market, **for this journal arrived at a time when many receivers offered to the public were sold without guarantee.** We felt that the home structor was entitled to free advice and to the assurance that the receivers described in our pages would live up to our claims, and also he should be able to feel that he could build a receiver with the same confidence and assurance of service as he would obtain were he to purchase one of the better class of receivers. **Notwithstanding the extremely low price at which it is possible to buy a receiver to-day, it is still necessary to pay a fair sum of money if satisfaction is to be obtained.**

Cheap Receivers are Seldom Satisfactory

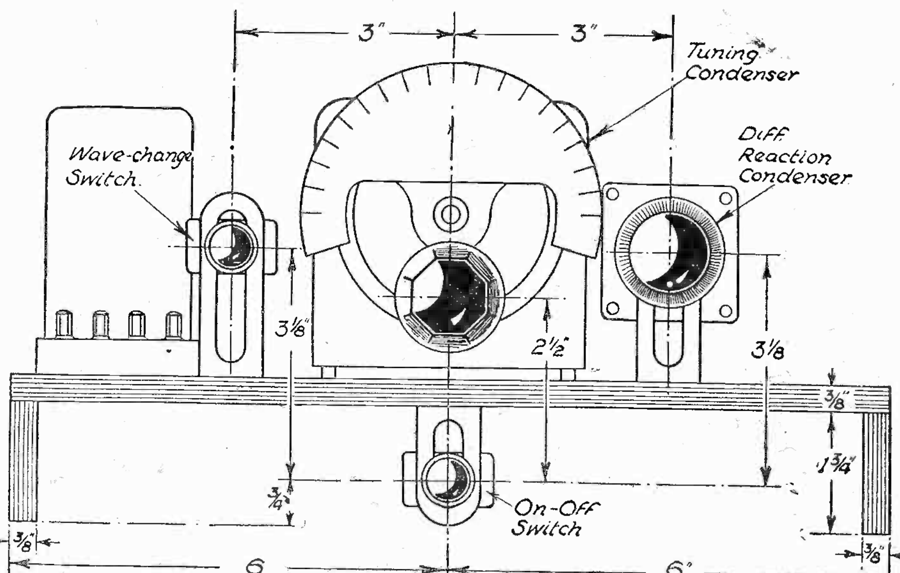
A large proportion of our correspondence is received from readers who complain in the bitterest of terms of their experiences with some of these cheap receivers, and from those who have failed to obtain the service to which they were really entitled from the manufacturers concerned. The policy of some of these manufacturers, we make bold to assert, is always to blame failure on the purchaser, and then to offer to service the receiver for a certain sum. Now we have taken the trouble to investigate some of the complaints of our readers on this score, and in every case we have found that no blame attaches to the reader concerned. **In every case we have found that the set has been badly made, wrongly connected, has had components left out, has arrived with parts broken, has defective valves, and in a large majority of cases the receiver could not possibly have been put through any test before its despatch to the retailer.**

This is a somewhat tragic state of affairs, but it is none the less true. We appreciate that price has a great appeal, and that readers may think in terms of price and to their sorrow consider the question of results and efficiency after the purchase, when it is too late to get their money back. **Particularly is this**

Neatness, com... are the...



From this top view of the receiver the small amount of wiring may be seen.



Drill your cabinet front from these dimensions.

OU... RE... TO T... CHE... REA... MA... SE...

NOTABLE "LEADE... FEATURES

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- SELECTIVITY *IN EXCELSIS*
- AMPLE VOLUME FOR HOME... TION
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HREE

LOW PRICE AND EFFICIENCY COMBINED!

nd simplicity of control of the Leader.

so in the case of some Hire Purchase arrangements, when, once the retailer has concluded the Hire Purchase arrangements, the whole of the transaction is immediately passed over to some finance corporation which is entirely unsympathetic towards the complaints and presses for the money as soon as the customer shows signs of being awkward. This does not, of course, apply in every case, but the reader should assure himself by demanding that the receiver be submitted to his house for approval for a few evenings so that he can satisfy himself as to its capabilities.

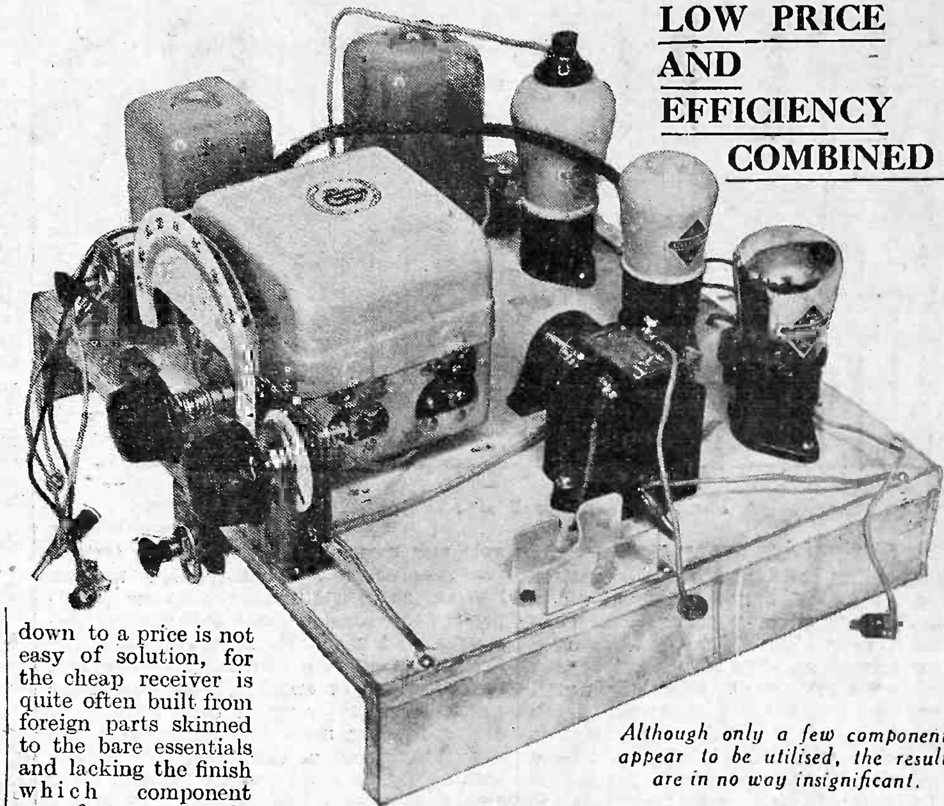
Sixty Shillings Only!

The LEADER THREE represents the first of the **PRACTICAL WIRELESS** Receivers to be designed down to a price, and the limit we set ourselves was 60s. We could have made an even cheaper receiver than this, but for the valve arrangement used we do not consider it desirable to go below this figure. **It is our reply to the price question, and in future our receivers will be designed with the price question borne in mind,** always remembering at the same time the question of efficiency.

This price question has been raised many times by our readers, but unlike the complete cheap receiver, we have attacked the problem from the point of view of service. We have mentioned many times before in these pages that we take a personal interest in receivers built by our readers, and we shall accentuate that interest in the LEADER. The only stipulation we make is the parts we specify must be used.

The problem of designing a receiver down to a price is not easy of solution, for the cheap receiver is quite often built from foreign parts skinned to the bare essentials and lacking the finish which component manufacturers apply to products intended for home constructors. Usually, the cheapest possible circuit arrangement is employed coupled with a cheap speaker and a cheap thin veneered three-ply cabinet and valves which have failed to come up to the valve manufacturer's tests.

In the LEADER, however, none of these objections apply, for we have been to a great amont of trouble and conducted very many experiments to ensure that the receiver has not suffered because of the paring down in price. And it is a remarkably efficient piece of work, specially designed to cover the new Lucerne wavelength arrangement. Although the coils are extremely cheap, we can accord them full marks for selectivity. There is no sign of break-through, and they have almost the efficiency, from the point of view of selectivity, of iron-core coils.

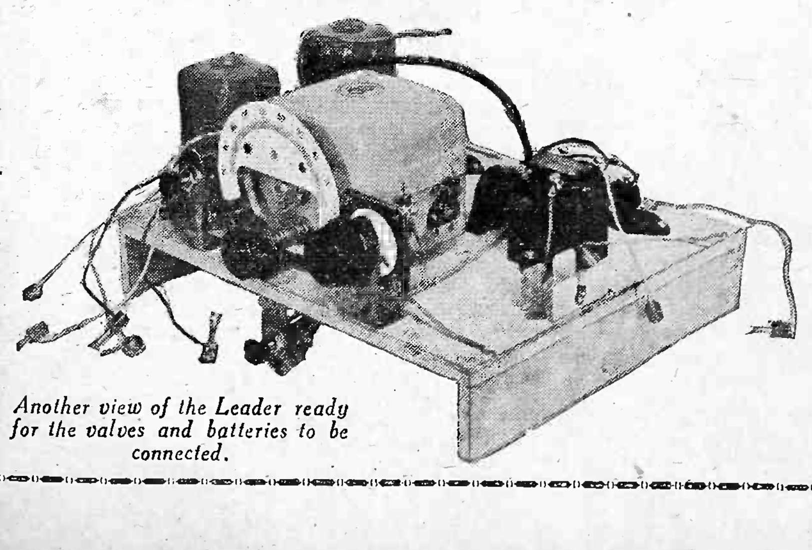


Although only a few components appear to be utilised, the results are in no way insignificant.

The Circuit

As was mentioned in the preliminary notes last week, circuit simplicity is the keynote, and as is so often the case (in wireless in particular) the simplest arrangement is conducive to the best results. Thus we have utilised a screen-grid valve of the ordinary type for H.F. amplification. Tuning has been accomplished by ordinary air-core coils in preference to those of the iron-cored type, and although selectivity would naturally have been higher with the latter type of coil, the principal consideration here was the accommodation of coils designed since the Lucerne Plan was put into effect. The very best may therefore be obtained from the reorganized wavelengths, and it will be noticed that the tuning range extends down to 150 metres

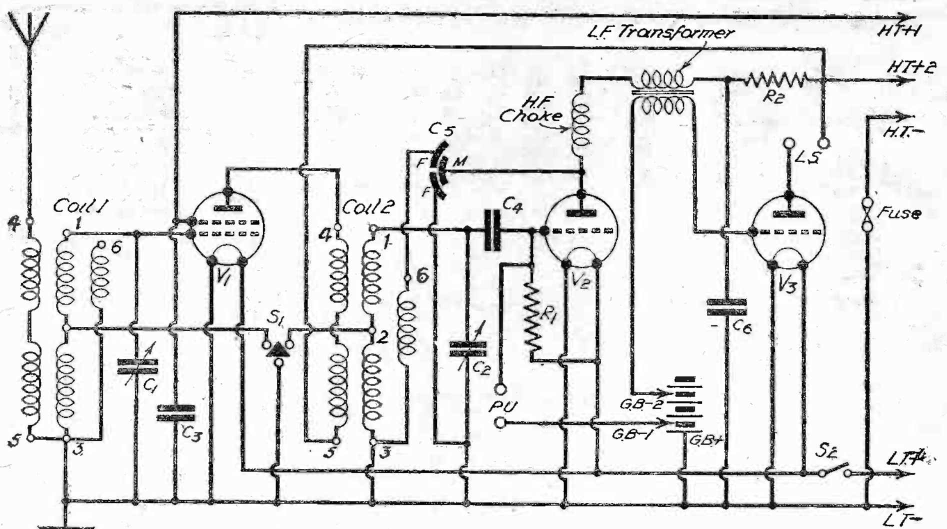
(Continued overleaf)



Another view of the Leader ready for the valves and batteries to be connected.

Use these parts for The LEADER and so make certain of excellent results.

- One "Metaplex" Chassis, 12in. by 10in. with 1½in. runners (Peto-Scott).
- One Double-Gang Condenser, "Nugang" Type A. .0005 mfd. (C1 and C2) (Jackson Bros.).
- Two "Universal" Screened Coils (Wearite).
- One .00015 mfd. Differential Reaction Condenser (C5) (Graham Farish).
- One "Niclet" 5 : 1 L.F. Transformer (Varley).
- Three Chassis Mounting Valve Holders (W.B.).
- One "Snap" H.F. Choke (Graham Farish).
- One 20,000 ohm 1 watt Electronic Resistance (R2) (Varley).
- One 2 meg. 1 watt Electronic Grid Leak (R1) (Varley).
- One .2 mfd. Tubular Fixed Condenser (C6) (Graham Farish).
- One 1 mfd. Fixed Condenser, Type 9200/B.S. (C3) (Dubilier).
- One .0002 mfd. Fixed Condenser, Type 665 (C4) (Dubilier).
- Two Terminal Socket Strips; one marked "A" and "E," the other "L.S." and "P.U." (Clix).
- Six Solid Plugs (for use with terminal strips) (Clix).
- One Grid Bias Battery Clip Type No. 2 (Bulgin).
- One Fuse Holder and Fuse Bulb, Type F.5 (Bulgin).
- Two "Junior" On-off Switches, Type S.38 (Bulgin).
- One 5-way Battery Cord, fitted with wander plugs marked "H.T.—" "H.T.+2," and "H.T.+" and spade terminals marked "L.T.+" and "L.T.—" (Belling Lee).
- Three Component Brackets (two long and one short) (British Radiogram).
- Three Valves: one S.G.215; one 210 Det., and one 215P. (Cossor).
- One High-Tension Battery (Lissen).
- One 9-volt G.B. Battery (Lissen).
- One 2-volt Accumulator (Lissen).
- One Cabinet (Peto-Scott).



The theoretical circuit of The Leader.

(*Continued from previous page*)

on the medium band, and from 750 metres on the long-wave band. Although air-cored, the method of winding these coils enables a very high degree of selectivity to be obtained, and in a simple set of this nature no greater degree of selectivity would be worth the additional expense.

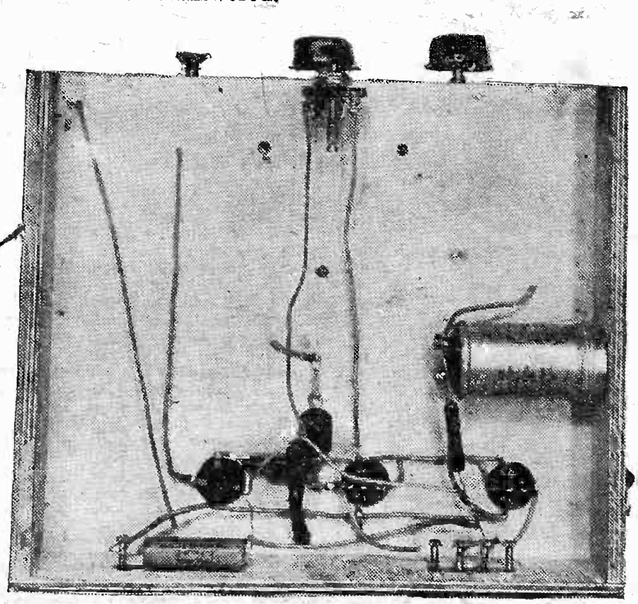
The output stage consists of a simple power valve which is fed by a highly efficient nickel-iron transformer. A pentode would admittedly give louder results, but it is more expensive, and would necessitate the addition of a tone-control arrangement which would lead to even more expense. To many listeners the output from a small valve of the type which is used is ample for the home.

There are only four controls on the panel—the main tuning control (operating a two-gang condenser), a wave-change switch, a reaction control, and the normal on-off switch. Operation is thus rendered extremely simple, and consists simply of turning the main control until the desired station is received, and increasing the signal strength if necessary by means of the reaction control.

Our standard chassis-form of construction has been employed, and this results in both ease of wiring and cleanness of appearance. The wiring will be found extremely simple, and should not take much longer than an hour to complete. It will be noticed that decoupling has been incorporated at certain parts of the circuit, and there is no risk of instability occurring when the receiver is employed with a dry battery or a mains unit.

The receiver is accommodated in a cabinet which is only just large enough to contain the chassis and this keeps the overall size of the apparatus down, but necessitates the use of an external loud-speaker. Many readers already own a speaker which they do not wish to part with, and the Leader may therefore be made up for use with that part of the equipment. The batteries may be placed behind the cabinet, or there may be room in the present loud-speaker cabinet for them.

We do not propose to devote any more space this week to test reports or other matters relative to this receiver, as we firmly believe that our readers prefer these constructional features to be restricted to a minimum of space. By doing this we can cater fully for those who are not, for one reason or another, interested in the particular receiver under discussion, and ample reading matter is afforded in the remaining pages of the issue. As we are continually pointing out, we exist to serve our readers, and whether the receiver is a multi-valve super-heterodyne or a simple one-valve set, we give the same guarantee of performance. You may therefore go ahead with the construction of the Leader in the full confidence that you will experience no disappointment from any point of view. The components are all selected for their efficiency in this circuit, and they are obtainable from Messrs. Peto-Scott, Ltd., whose advertisement appears on another page. The full-size wiring diagram which is presented free in this issue will assist you in carrying out the small amount of constructional work, and the finished receiver will be found absolutely fool-proof. In the unlikely event of a defective component causing trouble, or of any other difficulty which might arise through some unforeseen circumstances, the Free Service Bureau is at your service, and a letter will be promptly answered.



This view of the underside of the chassis will assist you in wiring.

TONE CONTROL

THERE are many receivers in use to-day which possess what is known as a tone control, but in many cases this term is erroneously applied. For instance, practically every circuit which employs a pentode output valve gives undue prominence to the higher notes in the musical scale, and to prevent a certain amount of shrillness it is customary to connect a fixed condenser with a resistance in series, across the output circuit of the pentode. This is known as a tone control, but it does not actually control tone. What it does do, however, is to limit the high-note response and thus enable a better balance of reproduction to be obtained. It has absolutely no effect on the lower notes and cannot, for instance, reinforce the bass, or balance up the strength of the reproduction of both treble and bass.

Tone control, to live up to its name, should enable the user of a receiver to adjust the reproduction so that any required degree of balance of tone is obtained, and the control should permit the bass to be strengthened, the lower and upper notes attenuated, or the upper notes to be strengthened at will, and should at the same time permit this to be carried out in a perfectly smooth manner, with one control which would not have to be turned through more than one complete revolution. The Multitone tone control transformer is a good example of complete tone control, and is designed for the purpose by a firm who have specialized in this type of work. The other four terminals on the transformer are connected in the orthodox manner. The high resistance then permits the reproduction to be varied over the complete range, giving reproduction which at one extreme is extremely deep, and at the other a high-pitched tone. Obviously, it is seldom normally necessary to carry the control to these extremes, but between them there is a complete variation which enables the reproduction to be adjusted so that the deficiencies of the receiver, the particular characteristics of the loud-speaker, or the personal prejudices of the listener may all be compensated for, and the resultant reproduction will be perfectly balanced. The inventor of this system, Mr. Poliakoff, has spent many years in investigation of sound reproduction, and, in addition to this special tone control transformer, he has also carried out some interesting experiments with regard to assisting the deaf to hear the wireless programmes, and the result of his experiments is embodied in a receiver which is being produced by Messrs. Multitone. This receiver is available in two models, one a five-valve self-contained battery receiver which requires no aerial or earth. It costs 20 guineas. The other model is for A.C. mains operation, and costs 24 guineas. In both of these receivers the circuit arrangements permit of the use of the apparatus in the standard manner, a loud-speaker being fitted to reproduce the programmes in the ordinary way. In addition, however, a special attachment is provided, at the inclusive cost, which permits the deaf to listen, at any required degree of volume to suit their particular comfort, without, however, affecting the volume required by others from the ordinary loud-speaker. In addition, the wireless receiver may be used by the deaf person to enable him to hear the conversations of friends, etc.

LEADER THREE

PILOT AUTHOR KIT
EXACT TO SPECIFICATION

The Pilot Kit SERVICE was founded in 1919.

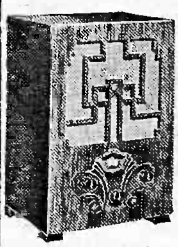
See the PILOT on the carton. It's a real guarantee.

TELSEN
323 STRAIGHT BATTERY THREE

Complete Kit of Parts in Sealed Carton, less Valves, Cash or C.O.D. Carriage Paid 29/6 or yours for 5/- down and 5 monthly payments of 5/3.

YOURS FOR 5/-

As above but with 3 Mazda Valves. Cash or C.O.D. Carriage Paid, £2/15/6, or yours for 5/- down and 11 monthly payments of 5/-.



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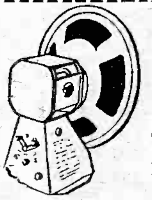

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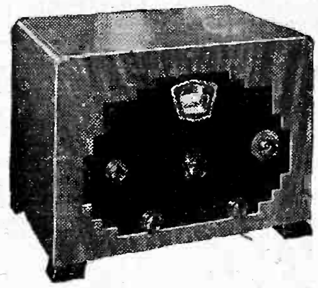

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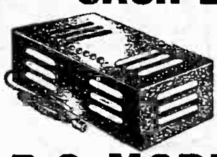

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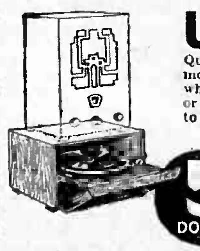

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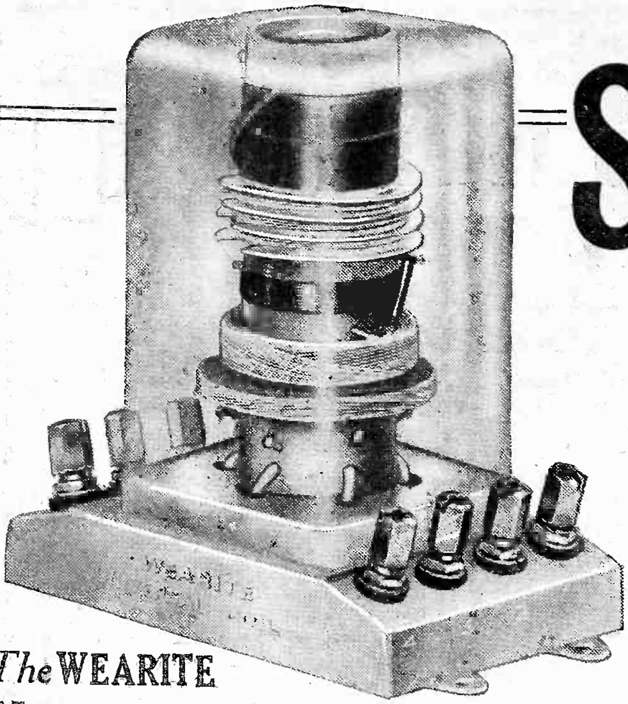

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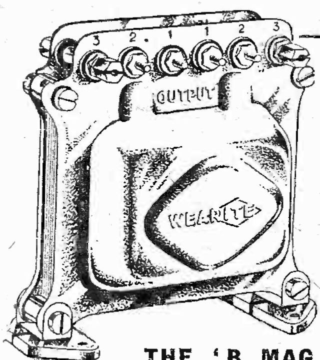

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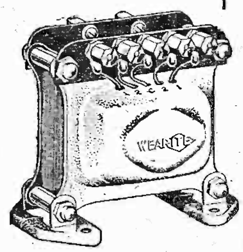

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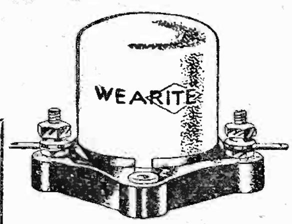

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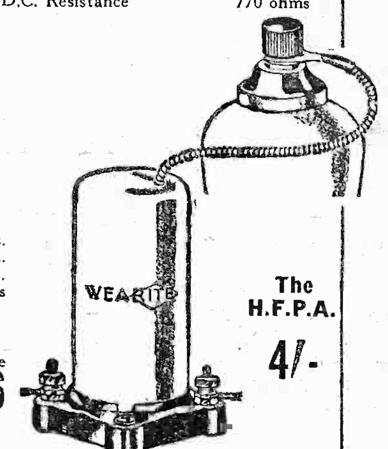

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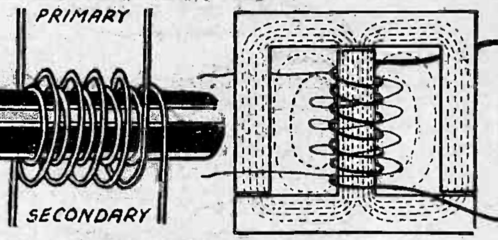


Figs. 7 and 8.—Two forms of iron core. Left, a simple iron rod ; right, a core which completely surrounds the coils of the transformer.

THE TRANSFORMER SIMPLY EXPLAINED.

This Article Explains in a Clear and Interesting Manner the Theory of the Transformer and Describes the Construction and Use of the Various Types.

IF a wire carrying a fluctuating electric current is placed near another wire it will create an electric current in the second wire in spite of the fact that there is no electrical connection between the two wires. This fact is illustrated in Fig. 1. A wire is connected to a battery and a switch as shown, while another wire, which is placed near the first, is flowing through the one wire can produce a current in the other, is because whenever an electric current flows through a wire it produces what is called a *magnetic field* round the wire ; that is to say, the wire exhibits properties similar to those of a magnet. Now, so long as the current flowing through the wire remains steady, the strength of the magnetic field will also

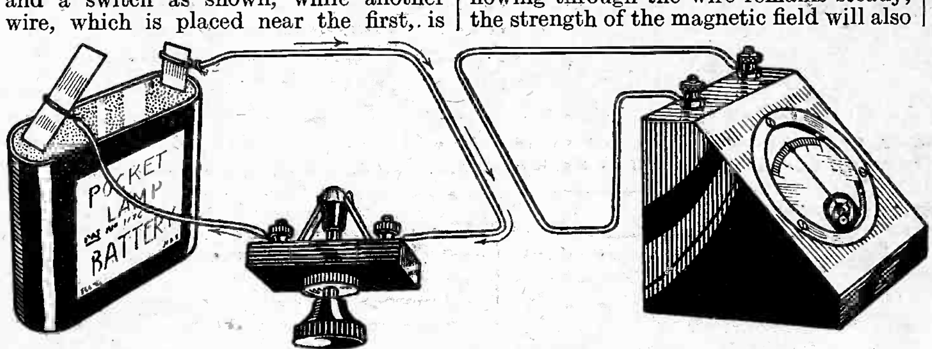


Fig 1.—Simple experiment to demonstrate the principle of induction, on which the working of a transformer is dependent.

joined to a sensitive galvanometer (current-measuring instrument). As soon as the switch is closed current from the battery commences to flow through the wire which is connected to it. In a fraction of a second the current rises from nothing to its maximum figure, after which it continues to flow at a steady rate until the circuit is broken by opening the switch again, when, of course, it ceases as suddenly as it commenced.

The Principle of Induction

Now if you watch the galvanometer while you make and break the connection between the first wire and the battery, you will notice that the pointer of the galvanometer gives a "kick" each time the switch is opened or closed, thus showing that at those moments a current also flows through the second wire.

This experiment is a simple demonstration of the principle of *induction* and is the principle underlying all *transformers*. The reason why the current

remain constant ; but if the current varies in strength, then, naturally, the intensity of the magnetic field will also vary. It is this variation in the strength of the

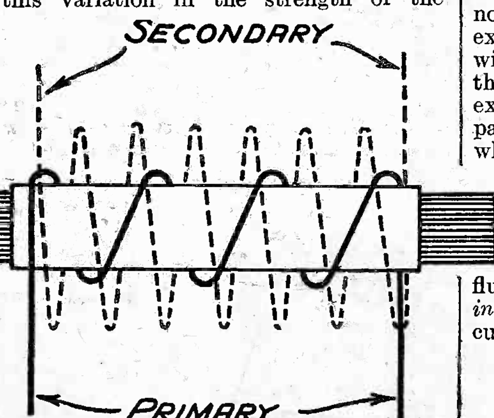


Fig. 6.—A simple transformer made of two coils of wire.

magnetic field which is able to produce an electric current in any other wire which comes within its influence.

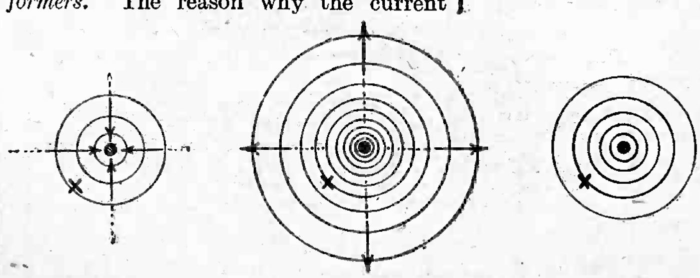
Lines of Force

Fig. 2 clearly shows how the magnetic field extends round a wire when a current is passing through it. The field is represented by *lines of force*, which are, naturally, closest together (showing the greatest intensity of the field) nearest to the wire. At the instant represented the current is flowing at a steady rate. Should the current suddenly increase, however, then the lines of force will expand outwards, followed by others which are still closer together until the field becomes stronger, as shown in Fig. 3. A decrease in current will have the opposite effect, and the lines of force will all contract inward until the field becomes correspondingly weaker, as shown in Fig. 4. Now suppose another wire be placed near this wire, say, at the point X, you can see clearly that a rise and fall in the current through the first wire, as shown in the three diagrams, will mean that the lines of force, in moving outwards and inwards, will pass through the second wire. In doing this they create a current in the second wire. When they move outwards they produce a current in one direction, and when they move inwards they produce a current in the opposite direction.

It should be clearly understood that *no current is produced in the second wire when the current through the first is flowing steadily.* It is only when it varies and so causes a movement of the surrounding lines of force that a current is produced in the second wire. This explains why, in the experiment just described, there was no movement of the galvanometer needle, except when the current through the first wire was started or stopped ; that is, at the moments when the lines of force expanded outwards, and in doing so passed through the second wire, and again when they "collapsed" inwards and once more passed through the wire.

However, if instead of passing a steady direct current through the first wire and making and breaking the circuit with a switch, we use one which fluctuates all the time, such as an *alternating current*, then a similar fluctuating current will be produced in the other wire.

(Continued overleaf)



Figs. 2, 3 and 4.—Diagrams showing the lines of force round a wire carrying an electric current.

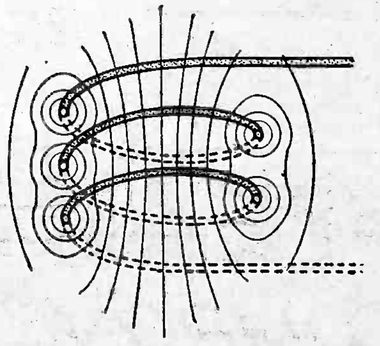
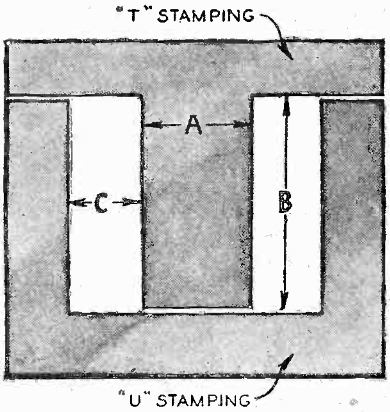


Fig. 5.—The magnetic field round a coil of wire.

(*Continued from previous page*)

A Simple Transformer

Now the magnetic field round a wire can be greatly intensified by making the wire into a coil, as in Fig. 5. Here you see how the lines of force, surrounding one turn, link up with those surrounding the next, and so produce an intense magnetic field whose centre or axis is down the middle of the coil.



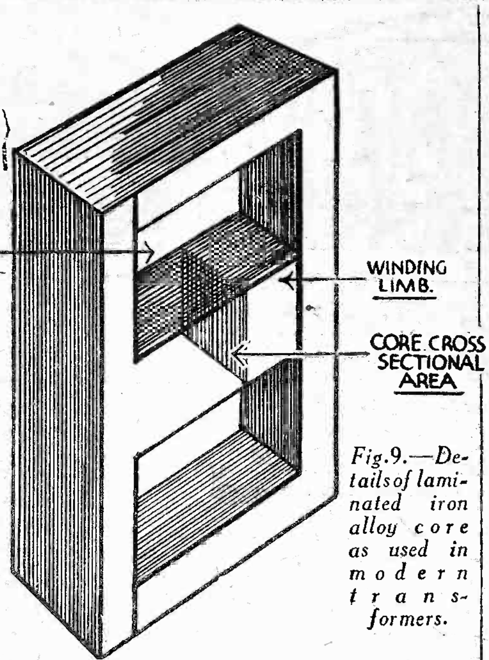


Fig. 9.—Details of laminated iron alloy core as used in modern transformers.

One of the simplest forms of transformer consists of such a coil with another coil of wire placed inside it, as in Fig. 6. If a fluctuatung electric current is passed through the first, or " primary," coil, then a current will also be obtainable from the " secondary."

Now the current through the *primary* bears definite relationship to that obtained from the *secondary*, and this relationship is dependent on the number of turns of wire in the primary coil as compared with that in the secondary coil. Thus, if there are ten times as many turns in the secondary as in the primary, then the voltage (or pressure) of the current from the secondary will be ten times that of the primary. Conversely, if there are less turns in the secondary than in the primary, say, half as many, then the voltage of the secondary current will be less than that of the primary—in this case, half the voltage.

Step-up and Step-down Transformers

A transformer having more secondary than primary turns is called a *step-up* transformer, while one having less secondary than primary turns is known as a *step-down* transformer.

It must not be concluded from the foregoing that a transformer is a miraculous appliance which will give any desired increase in the power of a current by merely using sufficient turns of wire for the secondary. It is true, of course, that the voltage can be stepped up to almost any desired figure by this means, but this does not mean that the transformer is a creator of power or energy, for every increase of pressure (voltage) is accompanied by a corresponding decrease of current (amperage).

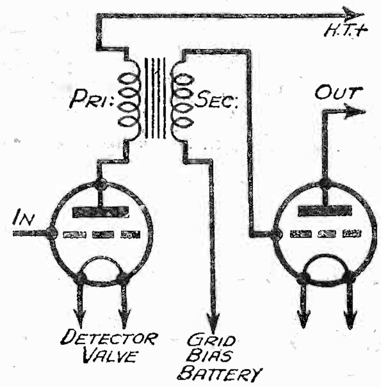


Fig. 10.—The commonest manner of connecting an intervalve transformer.

Whatever the design of the transformer the product of volts and amps. induced into the secondary cannot be greater than the product of volts and amps. flowing in the primary. Perhaps an example will make this clear. Suppose a transformer has a primary of 200 turns and a secondary of 800 turns, that is to say it gives a voltage step-up of four times. If it has, say, a current of 8 amps. at a pressure of 10 volts passing through the primary, then the current induced in the secondary will be (theoretically) 2 amps. at 40 volts. If the secondary turns are increased to 1,600 turns, giving eight times the voltage, namely 80 volts, then the current will be reduced to 1 amp. On the other hand, using less turns on the secondary will give a decrease in voltage, but an increase in amperage. Thus, 100 turns on the secondary will give 5 volts, but a current of 16 amps. The point is that the power given out by the secondary in each case equals that put into the primary, namely, 80 watts (volts x amps.).

Of course, these figures are those that would apply in the case of a *perfect* transformer, but since no transformer can be 100 per cent. efficient the power output is always slightly less than the input.

The Object of the Iron Core

To the radio enthusiast the most familiar type of transformer is the L.F. (low-frequency) intervalve transformer. This instrument has primary and secondary coils, but it is also fitted with an iron core. A simple iron core is shown in Fig. 7, and consists of an iron rod pushed through the middle of the coils.

Its object is to concentrate the magnetic lines of force round the coils so that the maximum number of lines cuts each turn of the secondary winding. The type of core used in an L.F. transformer is, however, more elaborate and completely surrounds the coils as in Fig. 8. The concentration of the magnetic lines of force within the core is shown by the dotted lines.

The core is not made of solid iron, but is composed of thin layers or laminations. This is to prevent the formation of electric currents called " eddy " currents which would otherwise circulate within the iron itself, due to the magnetic field. Such currents are merely a waste of energy and represent a loss in the efficiency of the transformer. Details of how the core of an L.F. transformer is built up are given in Fig. 9.

The coils of the transformer consist of many thousands of turns of insulated wire wound on a fibre bobbin. Usually one winding is wound on first with a layer of Empire tape or waxed paper as an insulating covering round it, and then the other layer is wound on top. Sometimes a layer of paper is also used between each layer of wire, apart from the layer separating the two windings.

Intervalve Transformers

L.F. intervalve transformers are usually of the step-up type and are used to

(*Continued on page 1106*)

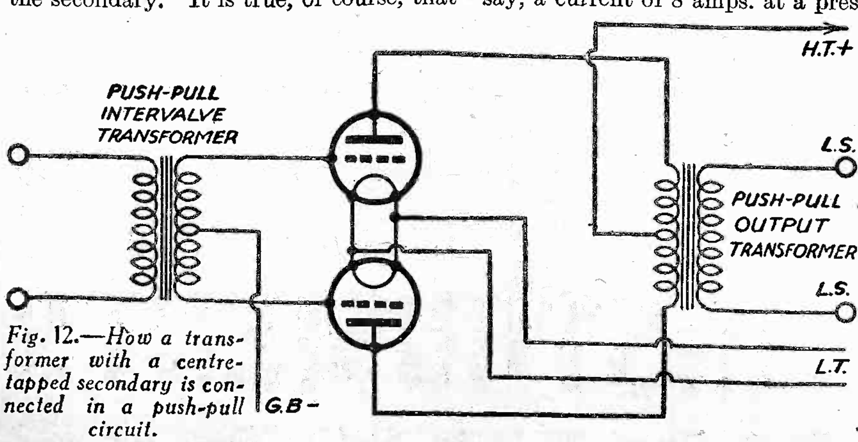


Fig. 12.—How a transformer with a centre-tapped secondary is connected in a push-pull circuit.

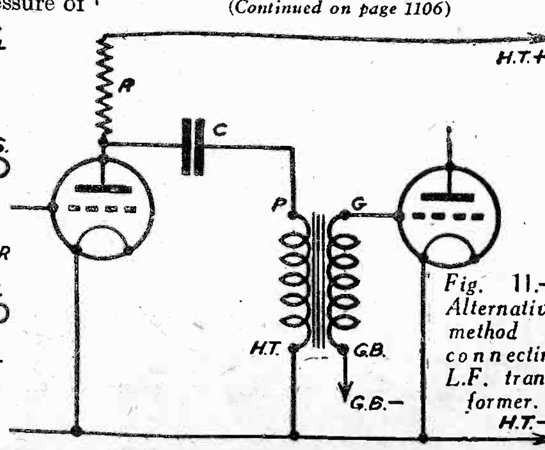


Fig. 11.—Alternative method of connecting L.F. transformer.

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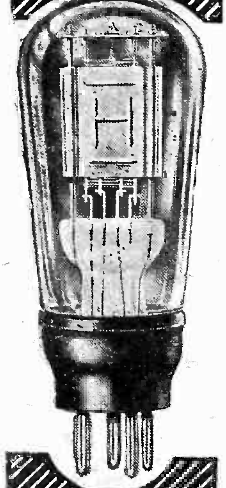

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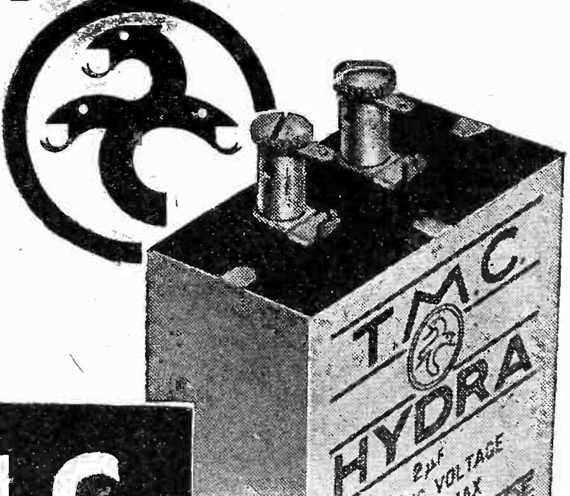

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SOUND ENERGY

The Acoustic Output of a Gramophone

By F. W. LANCHESTER

IN approaching this subject it is necessary to adopt certain conventions. The first is that we take as a basis the record of a pure tone, in which the form of the engraved needle track is a *sine curve*. The second is that we assume (from inspection of a number of records) a *maximum angle* of the needle track to the tangent or mean direction of same, calling this angle θ we take $\tan\theta = \frac{1}{6} = 0.166$. The third is that we take some definite velocity V as representing the velocity of the record under the needle point; actually this varies from 4 ft./sec. at the periphery of a twelve-inch record to about 2 ft./sec. at the centre. We shall take a mean value $V = 3$ ft./sec. The fourth is that the amplitude of movement of the needle is the maximum permissible, namely, assumed $= .005$in. The fifth is that the frequency is consistent with the foregoing; thus :—

Let a = the amplitude, namely .005in.
„ f = the frequency.
„ V = velocity of record under the needle point = 36 in./sec.
„ l = the length of an undulation $= \frac{V}{f}$ (inches).
„ θ = max. angle of track.

$$\theta = \frac{\pi a}{l} = \frac{\pi a f}{V}$$

$$\therefore f = \frac{V\theta}{\pi a} = \frac{36 \times .166}{3.14 \times .005} = 380 \text{ cycles}$$

per second.

That is to say, the frequency 380 is that which accords with the given values of a, V and θ.

There are two lines of approach open. The first of these is to compute the maximum possible output from the needle, the limit being reached when the needle jumps the track. This will give an upper limit. The second line of approach is to base our calculation on the amplitude of the acoustical wave in the throat of the horn, using the equation :—

$$\text{Watts} = \frac{(af)^2}{8}$$

For the first we require to know the limiting lateral force the needle can exert without leaving the track. By a simple experiment in which a weight is supported on three needle points on the face of a record, and the record tilted till the needles no longer hold, it is established a needle point will sustain a lateral force at least equal to its dead load; thus it is usually possible to tilt the record to 45 deg. or over before the needles lose their hold: for the present investigation *equality* will be assumed. A fair average figure for the weight borne by the needle is 4 oz., so we shall assume 4 oz. or 0.25 lb. as the maximum permissible lateral force.

According to the data already given, the maximum lateral velocity of the needle point is, $= V \tan\theta = 36 \times .166 = 6$ in./sec. $\therefore$ work done $= 0.5 \times 0.25 = 0.125$ ft. lbs./sec. That is the rate of doing work *on the steepest part of the sine curve*. The *mean value* is half this $= 0.0625$ ft. lbs./sec.

Converting this into electrical units, the limiting value of the power output is :—
0.084 watts,
or, 84 milliwatts.

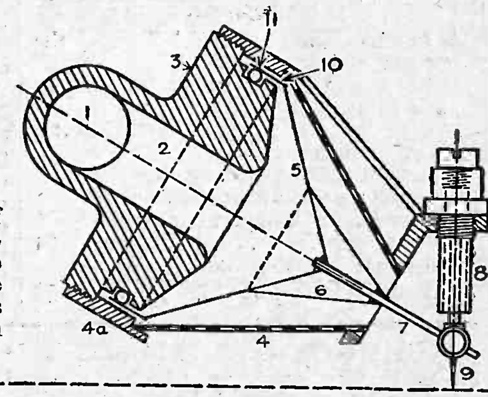

Fig. 2.—1 is an acoustic duct, leading to 2, Duct in tone arm forming first part of acoustic tube. 3, Main Casting. 4, Conical guard (perforated metal) held by 4a, Screwed ring. 5, Conical diaphragm or "piston." 6, Conical piston extension. 7, Piston rod, connecting to 8, Needle holder, and 9, Needle. 10, Piston skirt, supported by 11, India-rubber rolling ring or obturator.

Second Line of Approach

Some further data is required, and these concern the mechanical construction of the instrument. For this purpose the ordinary construction of gramophone is not well suited. In a gramophone designed and constructed by the author especially for the purpose of experiment and demonstration, the sound-box of which is illustrated in Fig. 2, a piston was adopted in place of the more usual flexible diaphragm, and the instrument was fitted with an acoustic tube of constant cross-section between the sound-box and the flare or horn; the disposition is in this respect similar to that shown in Fig. 3.

The data are as follows :—

Diameter of piston = 2.2in.
Area of piston = 3.8 sq. in.
Diameter (bore) of tube = 0.72in.
Area (bore) of tube = 0.40 sq. in.
Throat (area) ratio = 3.8/0.40 = 9.5.

The piston movement is *less* than the needle point movement, thus :—

$$\frac{\text{Piston movement}}{\text{Needle movement}} = \frac{2}{3}$$

$\therefore$ Piston movement $= \frac{2}{3} \times .005 = .0033$.

The amplitude of the sound wave in the acoustic tube, assuming no lost motion, is equal to the piston motion $\times$ the throat ratio : $= .0033 \times 9.5 = .0315 = a$. Now f we know $= 380$ $\therefore$ $af = .0315 \times 380 = 12$ $\therefore$ watts *per sq. ft.* (in acoustic tube) $= 12^2 \times .125 = 18$.

And area of acoustic tube = 0.40 sq. in.

hence, $\text{Power} = \frac{0.40 \times 18}{144} = .050$ watts
= 50 milliwatts.

This is well within the limiting value 84 milliwatts determined by the other method of computation.

On test the instrument was found to carry its load quite comfortably, and in order to explore the possibilities a new sound-box with a larger diameter piston was fitted. Before discussing this it is of interest to check the foregoing on the basis of diaphragm pressure.

Now $af = 12$, therefore pressure $= 12/210 = .057$ pounds per sq. in. and pressure force on piston $= .057 \times 3.8 = 0.216$ pounds. This gives: $2/3 \times 0.216 = 0.143$ pounds lateral force on needle point, or well within the permissible value.

The data relating to the second sound-box are as follows :—

Diameter of Piston = 3.4 in.
Area of Piston = 9 sq. in.
Diameter (bore) of tube = 0.75in.
Area (bore) of tube = 0.45 sq. in.

$$\text{Throat ratio (area)} = \frac{9}{0.45} = 20$$

$$\frac{\text{Piston movement}}{\text{Needle movement}} = \frac{2}{3} \text{ (as before)}$$

$\therefore$ Piston movement $= .0033$in.
Amplitude of wave in acoustic tube $= a = .0033 \times 20 = .066$in.
$af = .066 \times 380 = 25$.
$\therefore$ Watts per sq. ft. $= 25^2 \times .125 = 78$

$$\text{Power} = \frac{78 \times 0.45}{144} = .242 \text{ watts}$$
= 242 milliwatts.

The pressure is: $af/210 = 25/210 = 0.12$ pounds/sq. in.
Force on diaphragm $= 0.12 \times 9 = 1.08$ pounds, or, on needle point, $2/3 \times 1.08 = 0.72$ pounds.

Both the watts and the pressure-force are very much greater than permissible. On test, with a *fully-recorded* record, the

(*Continued on page 1106.*)

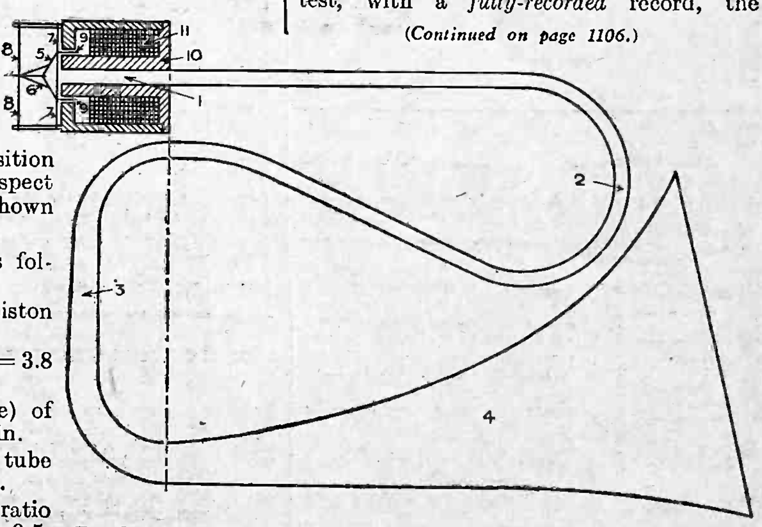

Fig. 3.—1 is a duct, leading to 2, Acoustic tube, leading to 3, Taper passage, communicating with 4, Final flare, or horn. 5, Conical diaphragm or piston. 6, Piston extension. 7 and 8 are Ligatures forming centring means. 9, Field gap with moving coil within. 10, Electro magnet (core). 11, Electro magnet winding.

SOUND ENERGY

(Continued from page 1105)

needle certainly would not hold the track, but with the load increased to 6 oz. (.375 lb.) the difficulty was overcome; theoretically it should have required far more. The discrepancy was undoubtedly due to the diaphragm or piston not being rigid—there is, in effect, "lost motion." Actually the conical part of the piston was intentionally made yielding (elastic) in order to give relatively greater amplification to the bass, and make good the deficiency in the lower frequencies which is usually an objectionable characteristic of the mechanical gramophone.

A computation on parallel lines of the power output on an H.M.V. "Exhibition" sound-box gave 22 milliwatts. The following is a summary:—

	Milliwatts
(1) Maximum possible estimate of power based on 4-oz. load on the needle point on assumption that lateral force may not exceed the dead load	84
(2) Author's special design with acoustic tube and 2.2in. piston	50
(3) Ditto, ditto, with 3.4in. piston and 6 oz. dead weight (certainly not realized)	250
(4) Corrected value for the foregoing based on highest possible lateral force on needle	60
(5) Computation of H.M.V. "Exhibition" sound-box..	22

If the theoretical figures could be realized, a good modern mechanical gramophone might be credited with a maximum acoustic output in the region of 20 milliwatts, when allowance is made for losses not taken into account in the calculation; the author would not feel disposed to credit a higher figure than 10 milliwatts as that actually reached.

Comparison with a low-power radio or electrical gramophone, having a power valve with an A.C. output of, say, 150 to 180 milliwatts, would suggest that either the above estimate is on the high side or the efficiency usually given for the moving-coil speaker on the basis of laboratory measurement is low. Both by theory and experiment the efficiency of a moving-coil speaker of the open cone type is not more than 5 per cent. This is an aspect of the subject that awaits further investigation.

BEGINNER'S SUPPLEMENT

(Continued from page 1102)

provide the coupling between valves in the low-frequency stages of a receiver. The transformer does not, of itself, amplify signals but steps-up or increases the fluctuations in the plate voltage of the preceding valve. These amplified voltage-fluctuations are then passed on to the grid of the following valve. The commonest method of connecting up the transformer is shown in Fig. 10, while the more recent "parallel-feed" method is shown in Fig. 11. In this latter method it will be noticed that a condenser C is connected in series with the primary winding. This serves to prevent the direct current from the H.T. battery from leaking through the primary of the transformer and the anode resistance R. It offers practically no opposition to the low-frequency impulses, however, which are imposed on this current by the speech or music being received, and which it is desired to pass on to the grid of the next valve.

A modification of the ordinary L.F. transformer consists in having *two* secondary windings. These are of equal size connected in series, thus giving three terminal connections, one of these being common to each winding. The two secondaries may be considered as one winding with a centre tapping, and are usually spoken of as such. A transformer of this type is used to operate two amplifying valves connected in "push-pull." The type of circuit used is shown in Fig. 12. The outer ends of the two secondary windings are each connected to the grid of one of the valves, while the third point or "centre tapping" is connected to grid-bias negative in the usual way. By using the valves in this way twice the signal strength can be handled, because the amplified voltage fluctuations induced in the secondary windings of the transformer are shared between the two valves.

Mains Transformers

Apart from coupling the valves, one of the most important uses of transformers in receiving sets is that of transforming the current supplied by the electric light mains into one of suitable voltage and amperage for working the receiver.

Mains transformers are very similar to intervalve transformers, but are larger. They usually have one primary winding and two or three secondary windings. The largest winding supplies the H.T. current for the valves; the next one has fewer turns of heavier gauge wire and supplies a comparatively large current at low voltage for heating the filaments of the valves, while a third winding is fitted when a valve rectifier is used. It provides the current for the filament of the rectifier.

Other iron-cored transformers are used to connect the last valve in a receiver to the loud-speaker. Usually the transformer is fitted to the speaker itself. It transforms the high voltage (but small current) from the valve into a lower voltage, but larger current suitable for working the loud-speaker.

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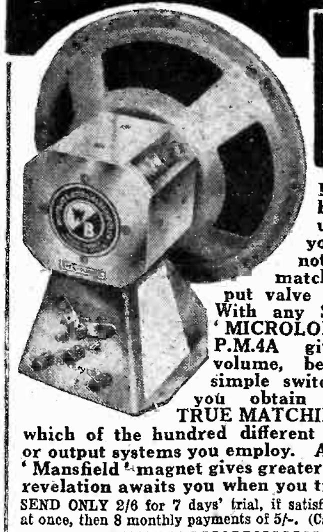

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Practical Television
Conducted by H. J. Barton Chapple, Wh.Sch., B.Sc., Etc.
MARCH 3rd, 1934. Vol. I. No. 9.

TELEVISION SWITCHING SYSTEMS

In This Article a Number of Methods of Switching Over from the Loud-speaker to the Television Receiver are Described

THERE are probably few experimenters who can afford to keep a special receiver for operating the television apparatus, and it becomes necessary to employ the same instrument for both "sound" and "vision" reception. Additionally, of course, it is generally more convenient to tune-in and make preliminary adjustments with the loud-speaker, rather than the machine, in circuit. On first thoughts it would appear to be a perfectly simple matter to insert a switch in the output circuit of the receiver to enable a rapid change to be made from speaker to machine, but when the question is examined rather more carefully and in detail there are a number of points which become evident. These can best be explained by considering a number of practical examples.

Series Feed

One of the simplest methods of connecting a disc-type machine is that shown in Fig. 1, where the neon and synchronizing coils are wired in series between the anode of the output valve and high-tension positive. There is a very appreciable voltage-drop across the neon and therefore it becomes necessary to provide an H.T. voltage well in excess of that actually required by the valve. Thus, if a switch were arranged simply to change over from the primary winding of the loud-speaker input transformer to the machine, an excessive voltage would be applied to the anode of the output valve, probably with disastrous results.

In the case of a mains-operated receiver this difficulty can be overcome most conveniently by including a resistance in series with the speaker transformer, as shown at R. Clearly, the value of the resistance must be such that the same anode voltage is applied to the valve whether the speaker or apparatus is in circuit. In other words, the value of the resistance must be approximately equal to the resistance of the neon: the resistance of the synchronizing coils can be ignored since it will not be very much different from that of the primary winding of the speaker transformer. A suitable value for the resistance is about 8,000 ohms, and such a value will nearly always produce the required effect. But if a high-resistance voltmeter is available the exact value can be found quite easily by using a variable resistance of about 15,000 ohms for R. First of all, the voltage between the anode and cathode of the output valve can be measured with the machine in circuit, after which the resistance can be adjusted until the same reading is obtained when the switch is turned to the "speaker" position. In regard to the switch itself, this should preferably be of the Q.M.B. type, since this is the only one which is really suitable for use in high-voltage circuits.

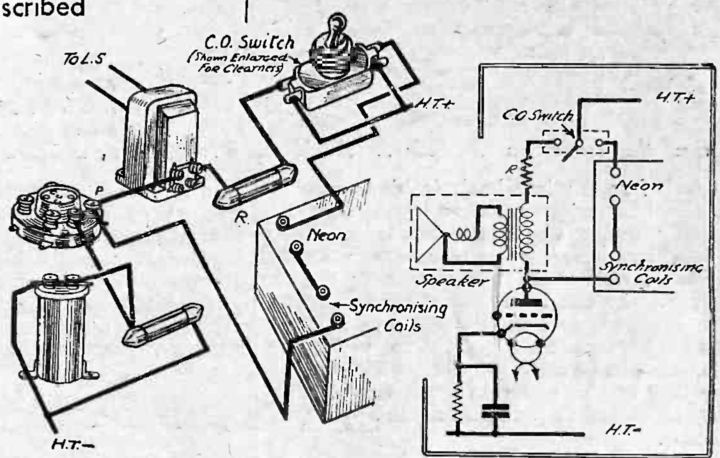

Fig. 1.—The method of switching from "sound" to "vision" when the apparatus is wired in series with the anode of the output valve.

A Pentode Precaution

There is another point to bear in mind when the output valve is of the pentode type; this is that the set should always be switched off before changing over from speaker to machine, or *vice versa*. The reason for this is that when the anode load is suddenly removed from a pentode, and when the suppressor grid is still positively biased, a high-voltage surge occurs which is often sufficient to ruin the valve. Of course, a multiple-switch could be employed that would automatically break the mains circuit when changing over, but the complication involved would not generally be justified.

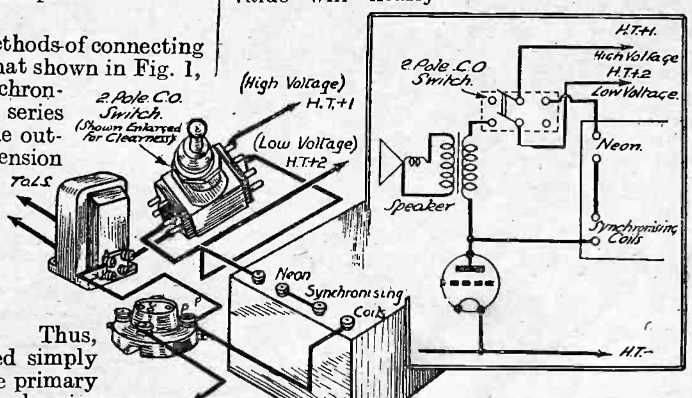

Fig. 2.—A convenient method of switching in a battery set using a single output valve, and where the apparatus is series fed.

Fig. 2 shows a similar arrangement to that already dealt with, but in respect to a battery-operated receiver where a separate voltage source is employed to supply the necessary "striking" voltage for the neon. A two-pole Q.M.B. switch is employed in this case, so that the normal H.T. voltage is applied when the speaker is in use, the additional voltage only coming into circuit on television. When the output valve is a pentode the same rule applies as was previously referred to.

Switching with Transformer Output

An entirely different method of switching is called for when the apparatus is fed through a 1 : 1 output transformer and the receiver is mains operated. Upon switching over to the speaker the high-tension load is reduced by the amount of current consumed by the neon, and therefore the supply voltage is increased; and, assuming an H.T. voltage of approximately 250, the load would be reduced by so much as some 25 milliamps, which is fairly considerable in proportion to the output of, say, a Class A rectifier. In order to maintain a uniform load a shunt resistance can be placed across the H.T. supply when the speaker is in use, and the method of providing for this is shown in Fig. 3. Here, the resistance R is in parallel with the H.T. supply during the time the speaker is in circuit. It will be obvious that R must have the same value as the neon and synchronizing coils, so that approximately 8,000 to 10,000 ohms will again be correct.

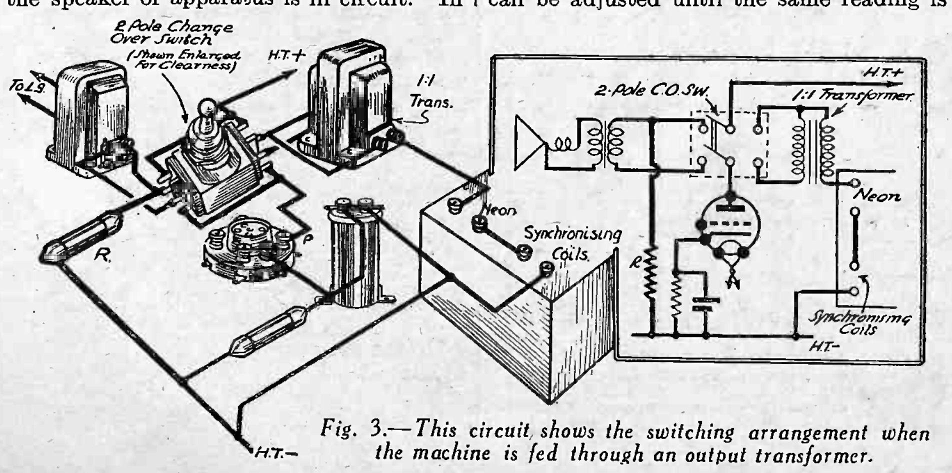

Fig. 3.—This circuit shows the switching arrangement when the machine is fed through an output transformer.

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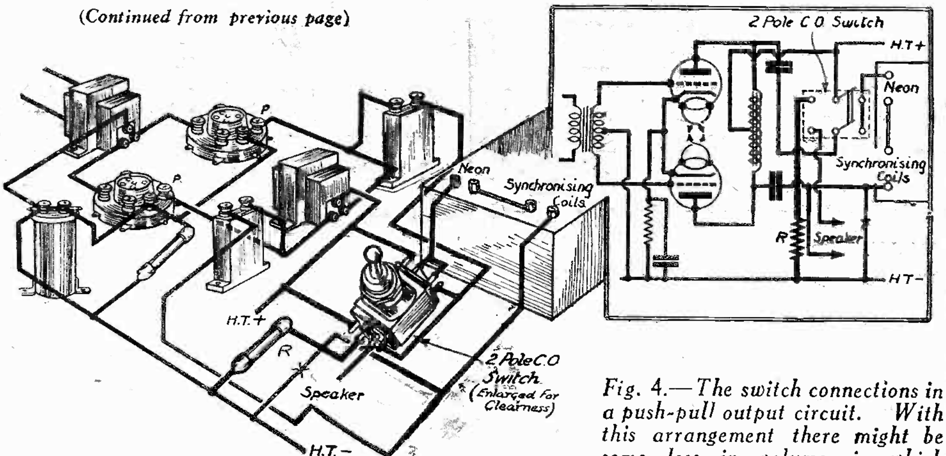


Fig. 4.—The switch connections in a push-pull output circuit. With this arrangement there might be some loss in volume, in which case the connection marked X should be "broken" by means of an on-off switch.

As before, it might be desirable to employ a variable resistance and to find the correct setting under working conditions. This could be done by measuring the anode voltage, as before, but a greater degree of accuracy can be obtained by measuring the total anode current with and without the apparatus in circuit. The resistance should then be adjusted so that the current reading is the same in both cases. The rule in regard to pentodes again applies, of course.

Switching in Push-pull Circuits

When a push-pull output circuit is employed, the system of switching over from speaker to machine is not greatly different from that just dealt with, and the connections are shown in Fig. 4. In this case it is assumed that a choke-capacity output feed is employed, whilst it can be seen that a double-pole change-over switch is used. When the switch is in the "television" position, the neon and synchronizing coils are fed with audio-frequency currents through the two fixed condensers, and the "striking" voltage is obtained from the normal high-tension supply. Changing over to the "speaker" position connects the loud-speaker to the two condensers and also brings the "balancing" resistance R into circuit between H.T. positive and negative, so maintaining a uniform load on the H.T. source. The method of determining the correct value for the resistance is precisely the same as was previously explained.

In the case of a battery-operated receiver, it will be obvious that the resistance is not required, and, in fact, must not be used, since it would merely cause a waste of current, and produce no good effect. The reason is, of course, that the output voltage of a dry battery is practically independent of the current load, whereas with nearly every form of mains-supply arrangement the voltage varies according to the load, becoming smaller as the current is increased, and greater when the current is reduced.

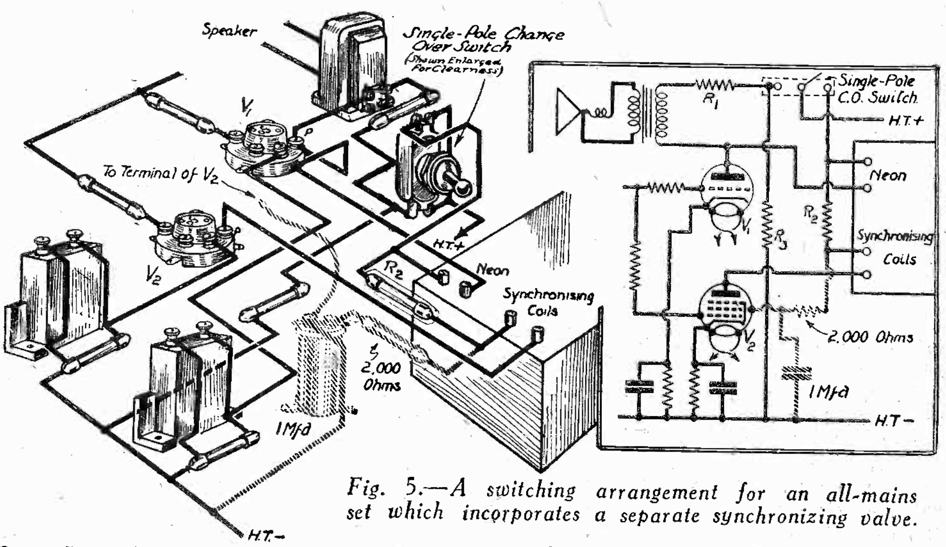


Fig. 5.—A switching arrangement for an all-mains set which incorporates a separate synchronizing valve.

When a Separate Valve is Used for Synchronizing

The switching arrangement becomes somewhat different when a separate synchronizing valve is employed, due to the fact that there are more circuits to consider. Fig. 5 shows one of the simplest arrangements, and this is entirely suitable for use with a receiver where the high-tension supply is from 350 to 500 volts. The circuit can more easily be followed if it is compared with Fig. 1, of which it is a rather more complicated form. Only a single-pole switch is employed. It is evident, for instance, that when the speaker is connected in circuit the voltage dropping resistance R1 is in series with the primary winding of the transformer, whilst the shunt resistance R3 "absorbs" a certain amount of current from the H.T. supply. The value of R1 is similar to that of R in Fig. 1; in other words, it is equal to the resistance of the neon. R3 must pass the same amount of current as the synchronizing valve V2 and the synchronizing coils. Its resistance can, therefore, be found by calculation when the normal anode current passed by V2 is known, or it can be found by inserting a milliammeter in the H.T. positive or negative lead and adjusting the value until the total current load is the same when the speaker is in circuit as when the apparatus is switched on. The resistance marked R2 is for the purpose of reducing the H.T. voltage to the correct value required by the synchronizing valve; the value can be found by calculation.

The arrangement shown is only suitable for use with a mains receiver, and in the case of a battery set R3 would not be needed, and it would be more economical to provide for the filament circuit of the synchronizing valve V2 to be "broken" when the loud-speaker was in use. Thus, a two-pole change-over switch would be required and should be connected as shown in Fig. 6.

It might appear that a similar arrangement would also be better even with a mains set, but there is a little difficulty which would have to be contended with. When the heater circuit was "broken" the load on the L.T. winding of the transformer would be reduced, so that there might be some danger of applying an excessive voltage to the heaters of the other valves. It is true that this difficulty would only appear when the "regulation" of the mains transformer was not all that it might be, but where any doubt exists it is always wise to "play for safety."

Another little point which should be considered in dealing with the arrangement shown in Fig. 5 is that if a pentode valve is used for synchronizing, the H.T. supply to its suppressor grid should be disconnected at the same time as its anode voltage; this can easily be provided for by employing the connections shown in broken lines.

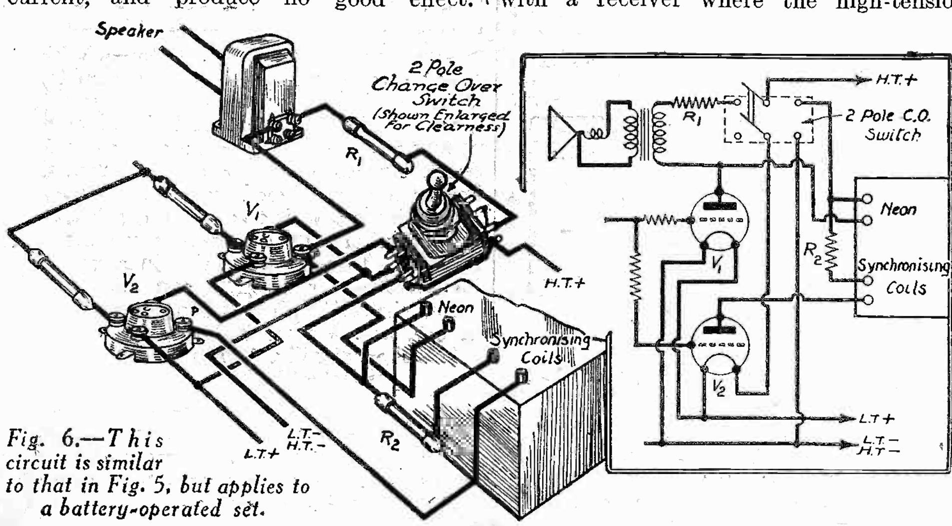
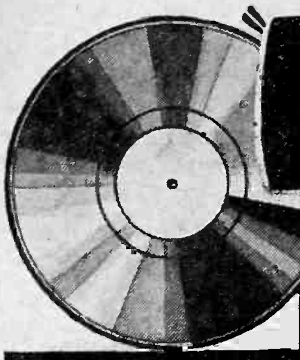


Fig. 6.—This circuit is similar to that in Fig. 5, but applies to a battery-operated set.



"Canned" Television

A Review of the Possibilities of Making Television Records, Accompanied by Some Practical Information

By H. J. BARTON CHAPPLE, Wh.Sch., B.Sc., A.M.I.E.E.

MANY have voiced the suggestion that it should be possible to record the television signals broadcast by the B.B.C. on some permanent or semi-permanent device which could be used to furnish images in the home at any convenient time. In other words, why is it not possible to duplicate for vision what the gramophone has done for sound ?

It will therefore come as a surprise to most readers to learn that the principles and practice of such a method were established about six years ago, Baird being the particular pioneer in the work. Unfortunately, the scheme, while practicable, is full of difficulties, as I will explain after I have dealt with the arrangement.

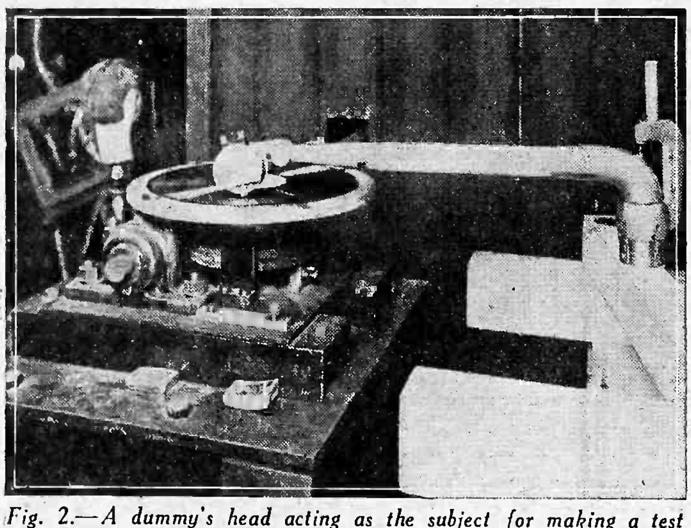


Fig. 2.—A dummy's head acting as the subject for making a test phonovision record, this latter process being visible in the foreground.

Making the Record

Our first concern, then, is the making of the record. From details which have been furnished in earlier issues of this journal the reader will remember that the subject or object to be transmitted is scanned by a regular and rapidly-moving spot of light, the reflections from the areas illuminated being made to operate photo-electric cells. This produces current effects which are proportional to the varying light effects, and being minute in character they are amplified in the normal way. These are the signals which are broadcast, but for our "bottled" images (phonovision is the name which has been applied to this section of television work) we vary the process slightly.

This will be made clear by a reference to Fig. 1. The scanning device (either a mirror-drum or disc, the latter being shown in Fig. 1 for simplicity) is driven from a motor which in turn is coupled to a turntable through reduction gearing. On this turntable is placed the blank record, and the vision signals, after amplification, are passed to a recording or cutting needle run in the plain record grooves. This makes indentations corresponding to the vision signals, and if it is desired to make the transmission a dual one, then a synchronized record can also be made of the accompanying sound produced by the subject before the transmitter. An alternative to this is to have a double recording track made on one record, one recording needle handling the sound and a second one the vision.

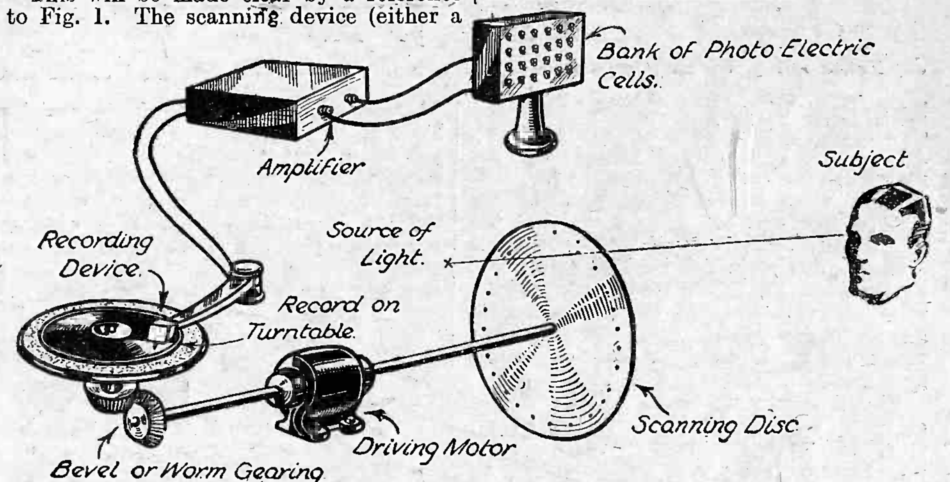


Fig. 1.—Pictorially illustrating how a record of a television transmission can be made in the studio.

Turning to Fig. 2 we see an illustration of an actual test record being made. On the left is a dummy's head fixed in front of the scanning device accommodated behind the partition, while in the foreground is the recording table. This is driven by a worm reduction gear coupled to the scanning motor shaft passing through the partition. The amplified signals are being fed to the recording needle in the normal fashion.

Playing the Record

A completed vision record made in this fashion is illustrated in Fig. 3, and differs from an ordinary sound record by having a characteristic wavy appearance. At the receiving end the process is reversed and this will be seen by studying Fig. 4. As before, one motor drives the scanning device (mirror-drum or disc) and turntable through a reduction worm gearing of exactly the same ratio as that employed

(Continued overleaf)

Fig. 3.—An actual phonovision disc record. When "played" on the appropriate apparatus instead of song or music being heard, the movements of an actual artist can be watched in the vision apparatus.

(*Continued from previous page*)

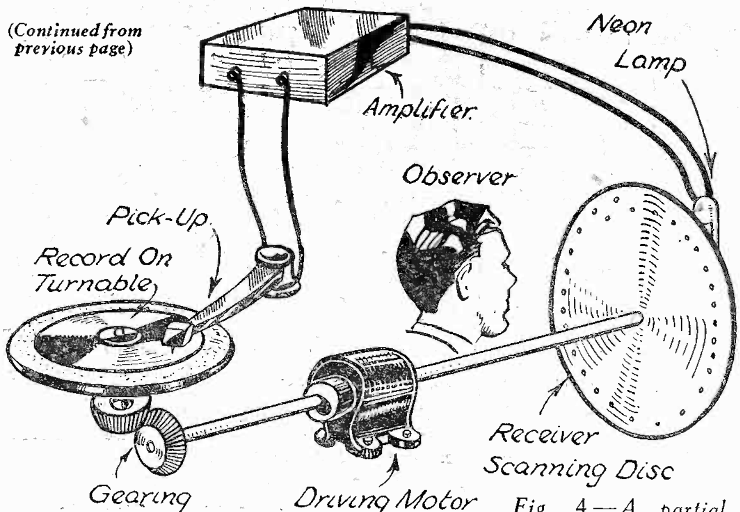


Fig. 4.—A partial duplication of Fig. 1 is undertaken when reproducing the recorded image.

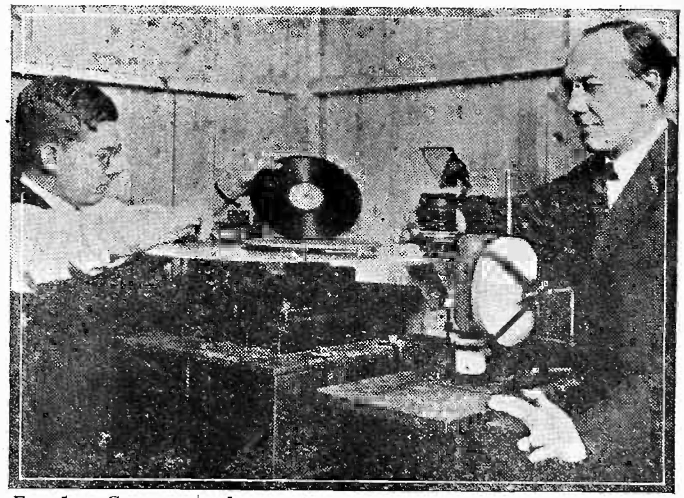
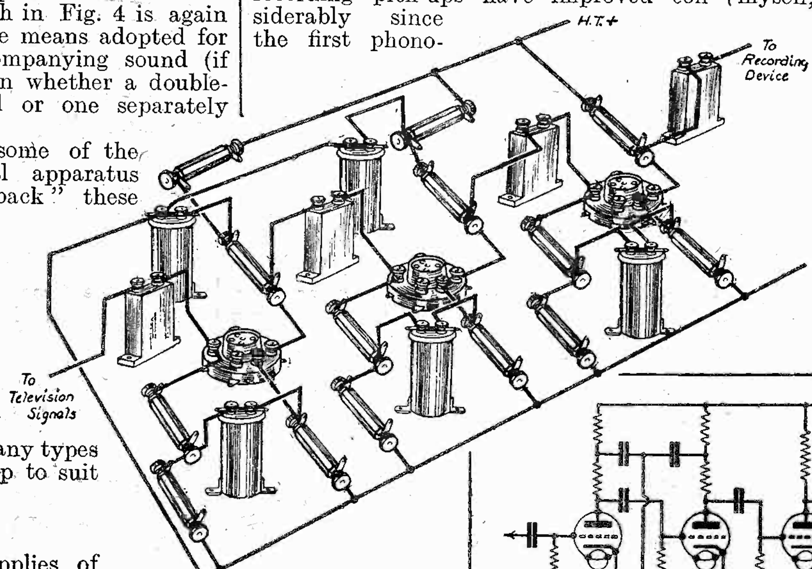


Fig. 5.—Getting ready to play over a Phonovision record so that the "bottled television" will be visible in the receiving apparatus.

by the transmitter (this should be marked on the record face itself to prevent error). An electrical pick-up "plays" on the record in standard fashion and the resultant signals, after amplification, pass to the light source and modulate it so that the images can be built up with the aid of the scanning device, which in Fig. 4 is again shown as a disc. The means adopted for reproducing the accompanying sound (if any) will depend upon whether a double-track record is used or one separately synchronized.

Fig. 5 represents some of the original experimental apparatus used in "playing back" these phonovision records. A particularly interesting illustration is that of Fig. 6, for it depicts how the resultant television image appears when built up from "canned" signals, the section of the receiver shown, of course, being one of many types which can be made up to suit individual taste.



Difficulties

Now why are supplies of such records, which would prove a boon to the experimenter, not available for general use? Well, first of all, one of the prime objects in employing these records is to test out home-constructed television apparatus at one's own convenience without being dependent on the B.B.C. It is, therefore, essential that the "bottled image" should be above suspicion. That is to say, frequency cut-off should not be present at either end of the wide range which has to be covered, and no resonance peaks must appear, otherwise they will be readily visible. Now, although recording pick-ups have improved considerably since the first phonovision records were made, they have not reached the stage of perfection demanded by television signals. Added to this, we have the fact that if an ordinary pick-up is employed to play back the record when carrying out tests at home, the results will fall short of those required for impartial investigation. The pick-up may be quite satisfactory for sound work, but the imperfections are very evident when "looked at" on the television screen. These, then, are the prime reasons why, at the moment, records are not made for re-sale, but this should not in any way prevent anyone from carrying out their own experiments, provided they appreciate that the results to be expected will not live up to "one hundred per cent."

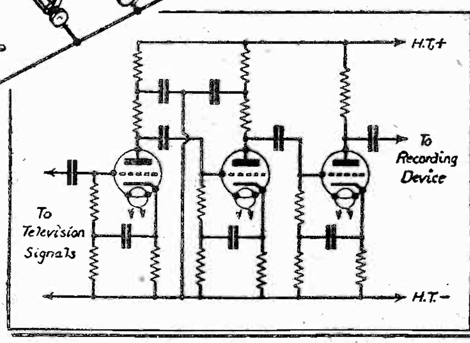


Fig 7.—The form of R.C. coupled amplifier suggested for recording and playing.

Fig. 6.—Showing how the "bottled" image appears in the television receiver when "played back from the record."

Home Recording

I have done this work several times myself, using one or two of the home-recording devices which have been on the market from time to time. The first criterion is to use a good low-frequency amplifier in conjunction with the recorder, preferably one embodying resistance-capacity coupling with low gain per valve stage. This same amplifier can also serve as the television signal amplifier when playing back the records after they have been mechanically indented in the disc.

A suggested circuit is given in Fig. 7, the method of connecting the amplified signals from the output valve naturally depending upon the type and nature of the recording pick-up, but this information is always furnished by the maker. A high-frequency-and-detector unit will obviously feed the received television signals into this amplifier. Although the arrangement of the unit required will be dependent upon the average reception conditions of the London National station, in the district in which the experiments are being conducted, as a general rule, within the service area of this Brookmans Park station, one variable-mu high-frequency pentode stage, followed by an anode bend detector valve coupling, without any form of reaction, will be suitable.

Whereas, in the case of studio-produced records, there is complete control over the synchronizing, as was indicated earlier in the article, when reliance has to be placed on the broadcast signals to be "bottled" for further use, difficulties creep in. Turntable speed must be dead steady, both when recording and when playing back, and even then, in the case of the latter an extra stage of low-frequency amplification, for feeding the superimposed synchronizing signals is advisable.

WILL THE PENTAGRID REVOLUTIONIZE THE SUPERHET?

(*Continued from page 1078*)

a section of which has a five miles per hour speed limit; even if the road is the same width throughout its length it will be obvious that the speed limit portion will have more vehicles per yard upon it than any other part where speed is normal.

A very brief consideration will show that this theory is quite untenable: electrons will pass through the grid "OG" at a very fast rate, and as soon as they enter the field of the heavily positive grid S_1 they will accelerate to a speed of at least 25,000 miles per second due to the terrific pull of S_1. This being so, how can the electrons possibly slow down? There is absolutely nothing to cause it; even the grid "T" is positive, what little there is of it. Quite obviously the electrons continue to hurtle towards their ultimate objective in space, which is the true anode "A," at a speed something like one-third of the speed of light (about 58,000 miles per second), which is the maximum speed that the electron reaches in a valve.

The true explanation of this valve runs on quite rational lines and is very easy to follow: Fig. 1 shows the electrodes referred to, while Fig. 2 shows how such a valve could be constructed. Reference to the first drawing will show that there are five grids and the heater, cathode and anode.

The heater "H" performs the usual function of warming the cathode "C." Next comes the innermost grid "OG," and then the grid "T," these two electrodes forming the oscillator portion of the valve, "OG" acting as the oscillator grid and "T" as the anode, just as if the other electrodes were not there.

As the inner grid will have a changing potential as the inner section of the valve oscillates, it will control the flow of electrons to the other valve composed of "DG" and "A," and will vary its slope; thus the incoming signal on "DG" will vary the anode current in proportion to the slope of this part of the valve. It has already been pointed out that the slope of the detector portion is controlled by the grid "OG," and in this way electronic mixing is brought about.

The working may be more readily understood if the incoming signal is a carrier wave only, and it is visualized in the following manner. The incoming signal swings up and down the characteristic curve of the valve, and at another speed the oscillator alternately makes the characteristic curve steep and flat. The anode current is controlled by the signal, but the degree of control is decided by the oscillator grid.

It is now evident how the pentagrid mixes the two waveforms by means of the electron stream *that is the only thing common to both portions of the valve.*

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REPLIES TO BROADCAST QUERIES

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Random Jottings

By the Editor.

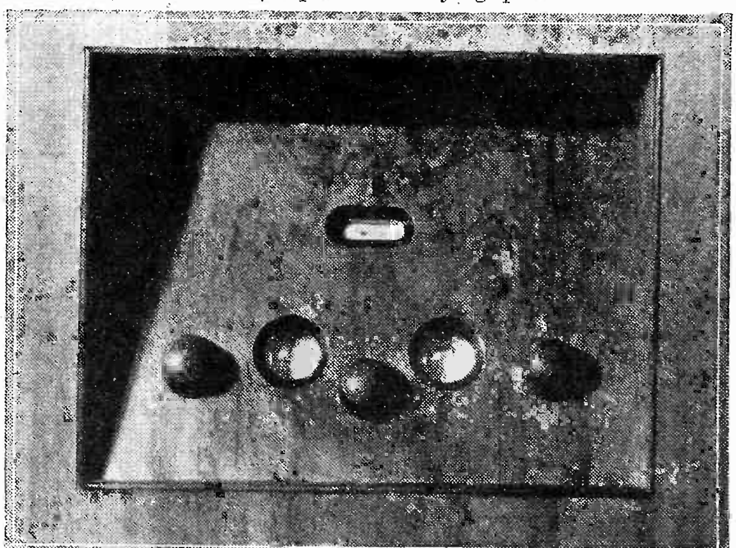
WE go to a lot of trouble to make the contents of PRACTICAL WIRELESS understandable to the beginner and expert alike. Now and again, however, we receive a letter from a reader who, without investigation of our information, jumps to conclusions. I had one the other day—Ah! here it is, from one W. R. Cumming, a wireless and electrical engineer of Dumfries. *Pace* Mr. Cumming:

"The theoretical diagram of the 'Reader's Wrinkle,' on page 988 of February 10th issue, entitled 'An Electric Bell Relay,' is wrong, for several reasons. Obviously if the theoretical diagram were used, it would be possible to arrange the bell batteries which are usually of higher potential than those in the normal receiver, either in parallel with, or in opposition to, those of the receiver. In the first case, premature discharge of the bell battery would occur, and in the second case, damage might be done to the receiver battery, since the resistance of such a bell circuit is normally negligible. The practical diagram is correct only up to a point, as the contacts will chatter, unless the frequency of the trembler is normally such that it vibrates synchronously with that of the bell. The result would be the reverse of the quietness suggested, which, it is stated, would allow the bell to be heard. A far simpler, cheaper, and more effective scheme is to run a lead from the bell circuit near the aerial terminal of the receiver, or if this does not produce a loud enough warning note in the speaker, then the lead may be connected to the aerial terminal through a small fixed or other condenser, having a value in the vicinity of .00001 mfd. to .0001 mfd., when it is usually possible to hear the 'Burring' note above the loudest passages of music. This latter method is well known and is very effective. With regard to 'A New Use for Old Transformers,' the secondary of one of the transformers is called upon to carry the anode current of the output valve. Secondary windings as a rule are not of sufficiently heavy gauge for this duty, so that the 'wrinkle' might be entitled 'Possible Way for Burning-out Secondary Windings of Old Transformers.'"

It seems necessary to point out to my critic that the theoretical and the practical circuits, as well as the text relating to this wrinkle, are quite correct and in order, but, as he is apparently unable to understand the scheme, may I say that he is quite wrong.

Firstly, no mention is made of a bell battery, simply because such is not required. Instead, the Low Tension accumulator is employed in the bell-wiring system, and if the circuit is examined it will be found that the customary make-and-break is not employed as in the usual bell system. Instead, the bell magnets are wired in series with the push, bell and accumulator. This means that when the push is operated, current will flow through the magnet system and the armature will be attracted and *held in contact with the poles of the magnet.* The accumulator is fed to the valves of the receiver, *viâ* the armature and the contact-breaker, which means that in the position of rest current may flow, and the switch on the receiver will enable the circuit to be broken at will. When, however, the armature is attracted to the magnets this current is broken, and therefore, as stated in the text, when anyone presses the bell push the set is switched off. If the striker is left on the armature this would give a blow on the bell gong as the set was disconnected, and although no continuous ringing of the bell is obtained this is unnecessary, as warning that someone is ringing the bell is obtained by the cessation of signals from the loud-speaker.

With regard to the second criticism, this reader may not know that transformers are capable of carrying quite a fair amount of current through the secondary winding. I have had some tests made in our laboratories and I give below the results of these tests:



The control panel of one of the new Ferranti receivers, which is fitted with magnifying lenses over the tuning scale. The horizontal opening at the top of the panel is the visual electric tuning indicator.

Transformer No. 1 (5/6 List Price). Secondary resistance 8,000 ohms. At 12 m/A temperature rise only just perceptible. At 30 m/A temperature did not exceed 80 degrees (cent.) after one hour's use, and showed no signs of breaking down.

Transformer No. 2 (30/- List Price). Secondary resistance 32,500 ohms. At 12 m/A temperature rise appreciable but no ill effects apparent after one hour's use, the sealing compound remaining set and the taping round the windings remaining unaltered in appearance. At 30 m/A breakdown occurred after 15 minutes.

It is obvious that the above treatments are absurd, as in the first case the voltage drop at 30 m/A would be 240 volts, and this obviously prevents the average user from applying sufficient H.T. to the output valve to pass that high current. It is safe in this case, therefore, to adopt the scheme of connecting the two transformers in series as the total current would be restricted to a safe figure. Incidentally the output valve of the average battery receiver does not pass current which in any way approaches this figure.

In the second case, 30m/A at 32,500 ohms gives a voltage drop of over 900 volts, and we cannot visualize any listener connecting this transformer in the anode circuit of a valve so as to pass this magnitude of current.

"Lucerne Specials"

THE month of February has not been associated with any outstanding activity in the production side of the radio industry. This is due mainly to the fact that February has been regarded as the month in which the threshold of the slack period is crossed. It is always the aim of the industry to keep its production graph as straight as possible, and, as far as the Marconiphone Company is concerned, this has been achieved by the introduction of the instruments known as the "Marconi Lucerne Specials." The demand for these instruments is truly astonishing, and the attitude of the buying public towards them ensures full production for some time to come.

The customary January rise in unemployment does not apply to Marconiphone. Additional operatives taken on at the beginning of last season to cope with the seasonal rush are being kept on, and further hands have been engaged. The Marconiphone factory at Hayes is as busy now as it was during the peak months of 1933. The maintenance of production during these reputed "slack" months has repercussions throughout various trades in Great Britain. The buying of the raw materials for making the "Lucerne Specials" creates further employment in all the associated industries, and it is from beginnings like this that the gloom of depression is lifted and prosperity once more returns.

Simpler Tuning

AMONG the many novel tuning arrangements which have been recently introduced in commercial receivers, that illustrated on page 1112 is worthy of special mention. It is a Ferranti scheme, and is fitted to the Arcadia and Lancastria models. It will be seen that small circular openings are provided for the actual tuning scales, and these openings are fitted with a powerful magnifying lens. This greatly enlarges the markings on the scale, and it is thus a simple matter for anyone to identify the actual setting of the tuning condensers. The illustration does not show these magnifiers to the best advantage owing to various reflections, but in actual use they will be found extremely efficient.

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Edited by F. J. CAMM

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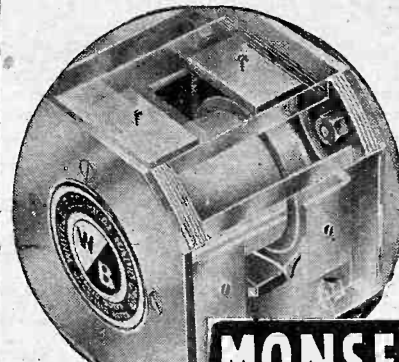

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RADIO CLUBS AND SOCIETIES

Club Reports should not exceed 200 words in length and should be received First Post each Monday morning for publication in the following week's issue.

SLADE RADIO

A lecture by Mr. E. N. Shaw, of the Marconiphone Co., Ltd., was given at the meeting held recently. In this he described the radio section of the works at Hayes. At the conclusion of the lecture a demonstration was given of the Model 262, which is a 5-valve A.C. superhet.—Hon. Sec., 110, Hillaries Road, Gravelly Hill, Birmingham.

GOLDERS GREEN AND HENDON RADIO SCIENTIFIC SOCIETY

On Wednesday, January 24th last, a talk was given to this society by Mr. J. C. Emerson, B.Sc., on "The Design and Testing of Home-Constructed Radio Receivers."—H. Ashley-Scarlett (President), 60, Pattison Road, London, N.W.2.

THE SIDCUP AND DISTRICT RADIO AND TELEVISION CLUB

An interesting lecture, "Metal Rectifiers," given by Mr. D. Ashby, B.Sc., of the Westinghouse Brake and Saxby Signal Co., Ltd., proved a great attraction at the last meeting of the above club. Mr. Ashby began by describing, with the aid of a series of lantern slides, the construction of the Westinghouse metal rectifier and how it depends for its action on the different resistances at the junction of a metal and an oxide, and he then explained in detail the various ways of using these rectifiers when it is necessary to convert alternating current into direct current.—Hon. Secretary, Mr. W. F. Smith, 4, Rowley Avenue, Sidcup, Kent.

THE CHATBURN AND DISTRICT RADIO SOCIETY

"Modern Radio Practice" was the title to a very interesting lecture given before the above society on the 9th inst. by Mr. Deal, of Messrs. Mullard, Ltd. The lecturer dealt in a very lucid manner with the functions of a radio valve. The society extends an invitation to all PRACTICAL WIRELESS readers in the district.—J. Holden (Hon. Sec.), Downham Road, Chatburn, Lancs.

INTERNATIONAL SHORT-WAVE CLUB (LONDON)

An interesting discussion, entitled "Is Short-Wave Listening Worth While?" took place at the London Chapter meeting held at the R.A.C.S. Hall, Wandsworth Road, S.W.8, on Friday, February 16th. Mr. A. E. Bear, in opening the discussion, said that short-wave listening was definitely worth while. Short-wave stations were increasing in number, and such stations as W3XAL, W8XK and the Empire stations were certainly giving service.

Mr. F. G. Sadler, in opposition, said that one could not listen on short waves with any degree of pleasure. A Canadian member said what a boon short-wave stations were to one whose nearest broadcasting station was over 500 miles away.—A. E. Bear (Sec.), 10, St. Mary's Place, Rotherhithe, London, S.E.16.

ANGLO-AMERICAN RADIO AND TELEVISION SOCIETY (Leigh Branch)

Readers, and others, in the Leigh, Lancashire, district are invited to attend the meetings of the Leigh Branch of the Anglo-American Radio and Television Society, which has just been formed by Mr. Harold Hughes, of 64, Siddow Common, Leigh, Lancs, from whom full particulars may be obtained.

This branch will hold meetings regularly, and television and other demonstrations will be given from time to time.

THE CROYDON RADIO SOCIETY

A loud-speaker night was held at St. Peter's Hall, Ledbury Road, South Croydon, on February 6th, the meeting being well attended.

The procedure was to find a speaker capable of challenging that of the Vice-President, whose instrument won at the last speaker night. This was his Baker moving coil, adapted specially by him and using 12 watts for energization. The Vice-President had entered a moving-coil designed, he said, on the Bitzoff principle.

At length a W.B. P.M.6 emerged triumphant in a final in which an energized dual unit, and several permanent magnet speakers participated. Finally, the Vice-President's was voted the best on all-round performance.—Hon. Secretary, E. L. Cumbers, Maycourt, Campden Road, S. Croydon.

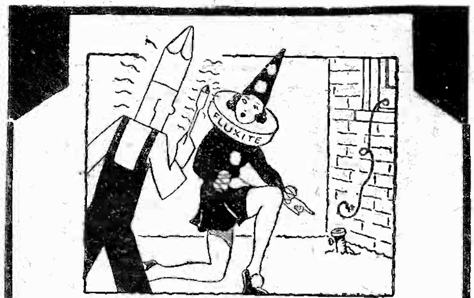
CLITHEROE ROYAL GRAMMAR SCHOOL RADIO CLUB

This club was formed on February 3rd, 1934, and has since had seven meetings. The club's activities for February included visits to the Palladium Cinema, Clitheroe, for a demonstration on sound apparatus and cine-projectors. On the 28th ult., a visit was paid to the North Regional Transmitter at Moorside Edge. Further particulars can be obtained from the Secretary, F. Duerden, Royal Grammar School, Clitheroe, Lancs.

INTERNATIONAL DX'ERS ALLIANCE

Under the auspices of this society the following special transmission will take place as follows:—

March 18th, 4.30–6.0 a.m. G.M.T., HIZ Santo Domingo, D.R. 6315 kc/s or 47.50 metres.—R. L. Rawles, Publicity Director, Blackwater Corner, Newport, Isle of Wight.



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The SET may look lovely—it may have cost much! To make SURE it is PERFECT—add this finishing touch!"

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ALL MECHANICS *WILL* HAVE

FLUXITE

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All Ironmongers sell Fluxite in tins: 4d., 8d., 1s. 4d., and 1s. 8d. Ask to see the FLUXITE POCKET SOLDERING SET—complete with full instructions—7s. 6d. Ask also for our leaflet on HARDENING STEEL with Fluxite.

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FIRST AND STILL FINEST
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with *Terminal* connections.

USE THEM FOR THE "LEADER THREE."

4-Pin with Terminals **8d.** Without **5d.**
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CLIX CHASSIS MOUNTING STRIPS AND SOLID PLUGS

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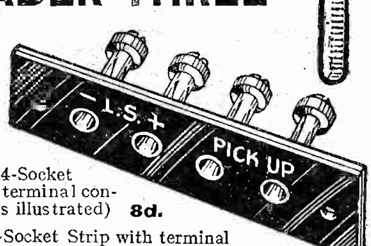

No. 23. 4-Socket Strip with terminal connections (as illustrated) **8d.**

No. 24. 3-Socket Strip with terminal connections for A1, A2, and E **7d.**

CLIX SOLID PLUGS for use with above **2d.** each.

CLIX WANDER-PLUGS for G.B. or H.T. **1½d.** each.

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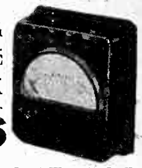
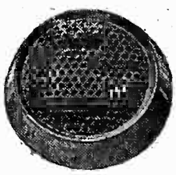
ELECTRADIX

DIX-MIPANTA VEST POCKET TESTER.



A wonderfully versatile moving-iron multi-range meter for service on A.C. jobs. No projecting terminals. THREE ranges of volts: 0-7.5, 0-150, 0-300. Used for MILLIAMPS reads: 0-12½m/A and 0-75m/A. In black bakelite case. Measures only 2½in. by 2½in. Complete in case with pair of test leads and plugs. **19/6**

Leaflet "W" gives full information.

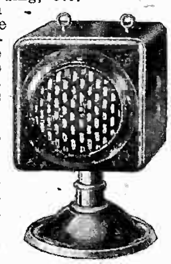


No. 11, 5/6

A NEW PRACTICAL HOME MICROPHONE for Broadcasting at Home. It is a general purpose, robust Mike, with solid bakelite body, back terminals, front metal grille, **No. 11.** New design, finely finished **5/6**

No. 11A. Special in solid Brass body, unequalled at the price on speech and music, **7/6.** Pedestal Mike No. 10B is 10in. high, **12/6.** No. 12B Ring Pedestal, **18/6,** as illus. Eilsel-reisz type Table Broadcaster, **52/6,** for Studio Recording, etc.

"P.W." TABLE No. 11 is a splendid little pedestal microphone for speech and music. The bakelite case containing a 2in. mike and transformer is on a bronze pedestal. Switch and plug sockets are fitted on the case. It stands unrivalled for quality and price **10/6**



"P.W." 11, **10/6.**

CROONERS Lapel Mikes for Dance Bands. American type model **12/6**

PARTS for Home Constructors. Buttons, **1/-** ea. Microphone Carbon Granules, in glass capsule, for four buttons. Grade No. 1, **8d.**; No. 2, Medium, **1/-**; No. 3, Fine, **1/6**; Carbon, solid back, blocks, **3d.** Mouthpieces, curved or straight, **10d.** Carbon diaphragms, 55 m/m., **4d.** Panel Brackets, pivoted, **5/-** Reed Receiver Unit for Amplifier making, **3/-.** Headphones, **2/9.** Leaflet with diagrams free.

COIL TURN COUNTERS, for checking the number of turns up to 9,999 on dial. Soiled only, **1/3** each.

METERS. We carry large stocks of Meters from **3/6** upwards. Switchboard Ammeters of 3in. to 8in. dial of from 0 to 10 amps. to 0 to 1,000 amps., both A.C. and D.C.

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BLUE SPOT 29PM. ...	32/6	4/5	7 of 4/5
ATLAS ELIMINATOR, No. CA25	59/6	5/-	11 of 5/6
B.T.H. Pick-up	21/-	3/10	5 of 3/10
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Old aerials rob you of good reception. Try this. Sling up a short length of SUPERIAL—the *modern* aerial. Test it against your old aerial, you'll get Better Tone, Keener Selectivity, More Volume. If you don't, we'll refund your money. Try SUPERIAL to-day.

100 ft.	75 ft.	50 ft.	25 ft.
3/6	2/6	1/9	1/-

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High Tension for your Radio from the Mains at 1/- PER YEAR

"MPR" ELIMINATORS make this possible
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Write to Dept. C. for full particulars

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IN OUR LABORATORY

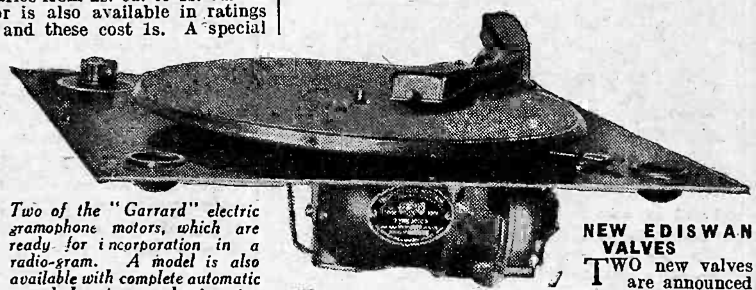
WHAT WE FOUND

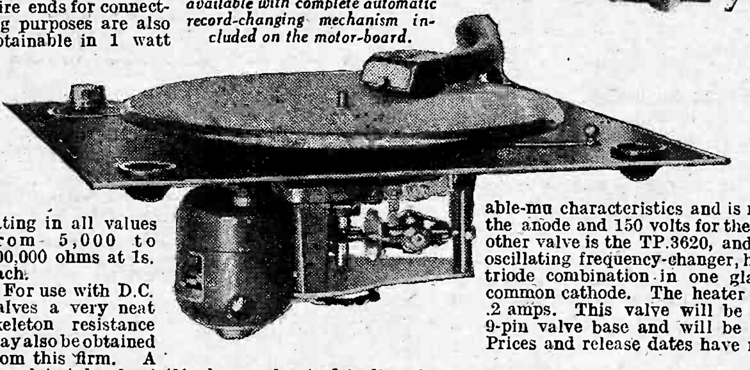
Tests of the Latest Components.

BULGIN RESISTORS

WHEN constructing a Mains-operated receiver there often arises the demand for a number of fixed resistors having various wattage ratings. In the Bulgin range will be found resistors having ratings from 20 watts downwards. The 20 watt type is wound on a heat-resisting core which is provided with a spiral groove throughout its length, and the element is a special non-ferrous nickel-chrome wire. Although these have various standard ratings, the method of making connection enables various intermediate values to be obtained. Metal bands are clamped round the wire and are fitted with terminals, and the element is held in place apart from these bands, so that there need be no hesitation in moving them to obtain any desired value. This type of resistance may be obtained from 50 ohms up to 100,000 ohms, and the price varies from 2s. 6d. to 4s. 6d. A smaller type of resistor is also available in ratings from 5 to 250 ohms, and these cost 1s. A special asbestos compound is employed for the former and the element consists of nickel-alloy wire. Terminal connections are provided and non-listed values may be obtained by connecting the resistances in series or parallel. Resistors of standard pattern, namely non-wire wound, provided with wire ends for connecting purposes are also obtainable in 1 watt rating in all values from 5,000 to 100,000 ohms at 1s. each.

For use with D.C. valves a very neat skeleton resistance may also be obtained from this firm. A porcelain tube about 4½in. long and an inch in diameter carries a fine wire element round which are clamped metal bands at fixed positions according to various mains ratings. These resistances are intended for vertical mounting, and a small bracket is supplied fitted to one end for this purpose. As this type of resistance dissipates some 50 watts as heat, ample space must be provided when assembling a receiver incorporating one of these devices. For 16v. or 20v. valves, and from 2 to 7 valves, the price is 4s.





Two of the "Garrard" electric gramophone motors, which are ready for incorporation in a radio-gram. A model is also available with complete automatic record-changing mechanism included on the motor-board.

EMICOL MEASURING INSTRUMENTS

SOME time ago we gave a report of the neat measuring instruments which are manufactured in London by the Electrical Measuring Instruments Co., Ltd. This firm now informs us that the public have apparently been led away by the cheap instruments which have appeared on the market and which owe their origin to Japan. These instruments, they state, whilst of quite an attractive appearance are unsound electrically, inasmuch as the resistance of the meters is very low, and this naturally means a load on the battery when checking H.T. voltages. The Emicol instruments have been designed to enable the amateur to make voltage and current measurements without any detrimental effect to his apparatus. Further, Emicol meters are guaranteed against defective manufacture. Our readers should bear these facts in mind when next purchasing an instrument.

EXCEL H.T. BATTERIES

WE have received from the Excel Battery Co. a sample of their 120 volt battery which retails at 5s. 9d. (carriage paid to any address). A similar battery with a voltage of 60 volts sells at 3s. 6d. It is claimed that a new and improved formula is employed in the manufacture of these batteries, and that, in spite of the extremely low price, good service is obtained from them. We subjected the battery to a discharge test, and obtained 50 milliamps for nearly an hour, with a drop in voltage to just under 100. This is drastic treatment, and in ordinary use the battery should be found to have a long life. An important point is, of course, that the batteries may be obtained direct from the makers (at the prices given above) and therefore the user is assured of obtaining a battery which is absolutely fresh. Where a battery is purchased through the usual trade channels there is always the fact that the shelf-life may have been of one week or one month's duration and the user thus has no indication of the freshness of the battery. Grid batteries are also obtainable at 9 volts for 7d. and 16½ volts for 1s. The address of the Excel Company is 151, Wellingborough Road, Northampton.

NEW EDISWAN VALVES

TWO new valves are announced by the Edison Swan Electric Co., and these are of the universal A.C.—D.C. type. The first is the VP.1321, and this is of the indirectly-heated type rated at 13 volts .2 amps. It is an H.F. pentode having variable-mu characteristics and is rated for 200 volts at the anode and 150 volts for the screening grid. The other valve is the TP.3620, and this is special self-oscillating frequency-changer, having a pentode and triode combination in one glass bulb, fed from a common cathode. The heater rating is 26 volts at .2 amps. This valve will be fitted with the new 9-pin valve base and will be supplied metallised. Prices and release dates have not yet been fixed.

BRITISH RADIOPHONE LINE DISCONTINUED

MESSRS. BRITISH RADIOPHONE, LTD., announce that the Standard A type flat type variable ganged condensers (with the trimmers mounted at the side) is being discontinued and will not be available as from the 1st March.

BATTERY H.F. PENTODES FROM MULLARDS

FOLLOWING our recent note of the issue of the T.D.D.2, we are able to announce that the Mullard Company will shortly be issuing two H.F. pentodes, also for battery operation. These valves will be known as the V.P.2 and the S.P.2, the former having variable-mu characteristics, and the latter an ordinary high-frequency pentode. The V.P.2 has the following characteristics:—

Filament voltage	2.0 volts.
Filament current	0.18 amps.
Max. anode voltage	150.0 volts.
Max. aux. grid voltage	150.0 volts.
Mutual conductance..	1.75 mA/V.

The S.P.2 has similar characteristics except that the mutual conductance is 2.2. mA/V. An important point about these two valves is that the auxiliary grid may have the same voltage as is applied to the anodes and this will enable the usual voltage-dropping resistance to be dispensed with, or alternatively will enable one battery lead to be removed. Even with this high grid voltage the anode current is still within reasonable limits being, in fact, approximately the same as that of a normal S.G. valve. The standard 7-pin base will be fitted and the valves will be supplied with a metallised coating only. This coating is connected to one of the pins on the base so that it may be earthed if desired.

A block condenser manufactured by the T.M.C.

WEARITE UNIVERSAL TYPE "A" COIL

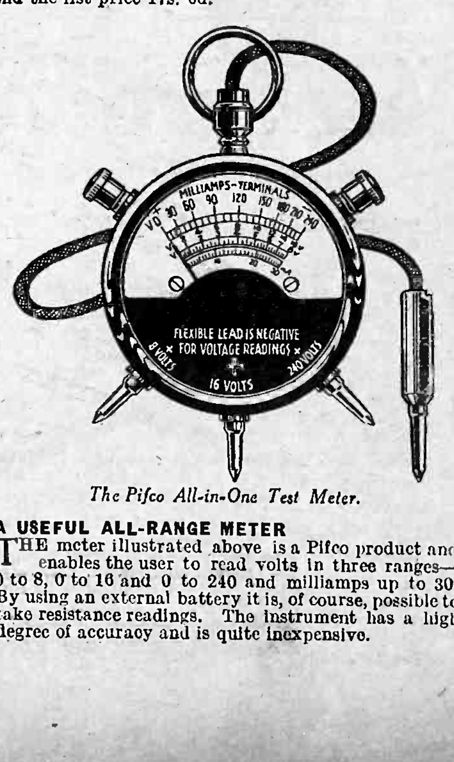
WE recently reported on the Universal coil manufactured by Messrs. Wright and Weaire and selling at 5s. This coil is now available in a second type, known as Type A, and it differs only in that a tapping point is now provided on the primary winding. This tapping point is brought out to Terminal No. 8 on the base and thus enables a higher degree of selectivity to be obtained where this is found necessary. Other advantages of this tapping will occur to the experimenter. The price will be the same, namely 5s.

OSRAM HEPTODE COMING

A COMBINED frequency-changer of the heptode type is announced from the G.E.C. This will be provided with the standard 4 volt 1 amp, heater, and will follow the lines of the heptode valve recently described in these pages. A standard 7-pin base will be fitted, and the reference number for the valve is M.X.40. The advantage of this valve over the normal H.F. pentode or tetrode method of frequency changing is in the fact that the conversion conductance is controllable by the grid bias. This makes the valve invaluable in circuits which incorporate automatic volume control where the maximum control is required and the number of control valves is restricted.

NEW EVER READY H.T. BATTERY

A NEW radio H.T. battery, suitable for replacement purposes in the latest model McMichael Lodex 5, has just been introduced by the Ever Ready Co. (Gt. Britain), Ltd. It is a 126 volts battery tapped at 70 and 120 volts for H.T., and six volts for G.B. The dimensions of the battery are 8⅞in. by 7½in by 3⅝in. The list number of this new battery is W.1252, and the list price 17s. 6d.



The Pifco All-in-One Test Meter.

A USEFUL ALL-RANGE METER

THE meter illustrated above is a Pifco product and enables the user to read volts in three ranges—0 to 8, 0 to 16 and 0 to 240 and milliamps up to 30. By using an external battery it is, of course, possible to take resistance readings. The instrument has a high degree of accuracy and is quite inexpensive.

PRACTICAL LETTERS FROM READERS

The Editor does not necessarily agree with opinions expressed by his correspondents. All letters must be accompanied by the name and address of the sender (not necessarily for publication).

A Rival to "Q.P.P."

SIR,—The accompanying rare woodcut of the period illustrates a dramatic moment in the development of my latest brain-child, "Quiescent Scratch-Scratch," and was recorded by a televisitor through the infra-yellow haze. For obvious reasons, I cannot reveal too much of my new system, but I can hint that it is a remarkable

modification of "Q.P.P.," and that valves are unnecessary. The heart of the whole thing is the synthetic crystal "Chokite," a combination of the rare elements Nertzite and Aertite, fused by the Darkhousen's Curse method. Prodding-pegs, mounted on either side of the mounted crystal, do all the pulling and pushing, and these are worked by hand, no electric mains being required. Further information I cannot give, at present, but when the system passes the experimental stage, and is in general use, valves, batteries, and the B.B.C. will be a thing of the past, and listening-in a meaningless function. My remarkable success is entirely due to the wonderful self-igniting "Inspirator," without which I should not have developed "Q.S.S.," or anything else.—(Dr.) GASPARD HACKENOFF (Institution for Eccentrics, University of Timbuctu).

Q.P.P. *versus* "Class B"

SIR,—As a reader of PRACTICAL WIRELESS since No. 1 I have taken a great interest in the progress of your journal, and in the trend of set design, I notice the great popularity of Class B sets. I have heard several sets with this type of amplification, and nearly all of them suffer from a kind of "Class B" rattle. To come to the point, I think that Q.P.P. is better than Class B when properly adjusted. I have experimented with the former, and strange to say, was disappointed with regard to volume with my first venture, it being about the same as my former set with a 10–1 coupling unit and pentode output. I therefore tried an L.F. transformer "in front" of the Q.P.P. stage—result terrible! Not to be outdone, I pulled out the transformer and replaced same with an L.F. choke; results splendid, both as to volume and tone. Idling current is 8½ m.a.; not too bad for a S.G. det. L.F. and Q.P.P. set. Variable tone control is fitted to the first L.F., and all valves are Tungsrams with pentode output driving three balanced armature speakers, or rather two and one of the inductor type. The battery is a 120 volts Standard No. 3 wet battery which has the advantages of keeping its voltage; the tappings are at every 1½ volts, just right for Q.P.P.! It was installed last March, and still shows 115 volts under load, so I am certainly saving in H.T. On the other hand, a size larger accumulator would be an advantage! I fully believe that with the advent of the new Marconi valve, Q.P.P. will take its rightful place, and share the great popularity of Class B.—R. G. HARRISON (Newcastle).

Sets Designed by Readers

SIR,—For some time past you have embodied a very popular feature in PRACTICAL WIRELESS, which consists of original ideas contributed by readers. I consider it would be a good idea if you invited readers to contribute short descriptions of actual sets which they have designed and constructed themselves. This would add greatly to the knowledge of everyone, and would provide splendid material for the man who likes to try different kinds of circuits. The idea occurred to me after I had constructed a set from my own design, and I thought it would be interesting to read of other amateurs' experiences.

My set is a 4-valve superhet. Heptode frequency changer, var. mu H.F. Pentode as I.F.; D.D. Triode detector and 1st L.F., and Pentode (Catkin) Output. Iron core coils are used. Although the set is not in its final form, whilst it is on an experimental board, practically every worth-while European Station, and also Pittsburg (KDKA) on 306 metres has been received.—E. H. GRIFFITHS (Barnet).

CUT THIS OUT EACH WEEK.

Do you know

—**THAT the anode by-pass condenser in the detector circuit will govern the amount of high note cut-off.**

—**THAT the heater windings on a mains transformer act as earth screens if interposed between primary and secondary.**

—**THAT a push-pull stage will work with one of the push-pull valves removed from its socket.**

—**THAT a Class B valve will still work even though one half is defective.**

—**THAT in cases of serious distortion with this form of amplification each half of the valve should be tested with a milliammeter.**

—**THAT a rubber band round a valve will do a lot to prevent microphonic noises.**

—**THAT whistles in a superheterodyne receiver may be caused by an overloaded detector valve.**

NOTICE.

The Editor will be pleased to consider articles of a practical nature suitable for publication in PRACTICAL WIRELESS. *Such articles should be written on one side of the paper only, and should contain the name and address of the sender. Whilst the Editor does not hold himself responsible for manuscripts, every effort will be made to return them if a stamped and addressed envelope is enclosed. All correspondence intended for the Editor should be addressed: The Editor,* PRACTICAL WIRELESS, *Geo. Newnes, Ltd., 8-11, Southampton Street, Strand, W.C.2.*

Owing to the rapid progress in the design of wireless apparatus and to our efforts to keep our readers in touch with the latest developments, we give no warranty that apparatus described in our columns is not the subject of letters patent.

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Everything radio supplied on convenient terms. For *really* prompt delivery entrust your order to us. Goods ordered cash or C.O.D. despatched same day. Strict privacy. Carriage Paid. Price List FREE.

PERMANENT MAGNET M.C. UNITS.

	Cash Price	Payment with order	No. of Months	Monthly Instalments
Blue Spot 99 PM (Still the best unit)	59/6	5/-	11	5/6
Blue Spot 45 PM	45/-	5/-	9	5/-
H.T. ELIMINATORS.				
Atlas CA 25	59/6	5/-	11	5/6
Atlas DC 15/25	39/6	5/-	7	5/6
VALVES (battery)				
Set of 3, 1 S.G., 1 Det., 1 Power (all makes)	31/3	5/-	6	5/-
AVOMINOR universal testing meter	40/-	5/-	7	5/6

All types of A.C. and D.C. Valves also supplied.

To avoid delay, will customers kindly send first payment with order!

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11, OAT LANE, NOBLE STREET, LONDON, E.C.2

TELEVISION IN THE NEW HEAYBERD HANDBOOK

The third edition of the Heayberd 1934 Handbook is just published. Have you got your copy?—if not, get it NOW. Contains a SPECIAL TELEVISION SUPPLEMENT with blueprints of Kits of Parts for various television uses. Fifteen blueprints showing how to build your own Mains Unit, Battery Charger, etc. Two pages of technical hints and tips for all amateurs. Cut out this advt. and send with 3d. in stamps for your copy.

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WIRELESS GUIDE—No. 296A

A WELL-ILLUSTRATED booklet bearing the above title contains prices and particulars of many of the leading radio manufacturers' receivers and components. A comprehensive range of valves, loud-speaker units, accumulators, high-tension batteries, eliminators, gramophone motors, meters, in fact, everything the constructor is likely to require, is given in this 120-page booklet. It is issued by J. H. Taylor and Co., Macaulay Street, Huddersfield.

"WIRELESS AS A CAREER"

WIRELESS amateurs thinking of taking up radio as a career would do well to obtain a copy of a brochure entitled "Wireless as a Career," which gives particulars of the National Institute of Radio Engineering, methods of instruction, and full synopsis of the course for qualifying for the N.I.R.E. diploma. Particulars of a correspondence course are also given. The principal of the Institute is Mr. H. F. Yardley, A.I.E.E., and the address is 55-57, Guildhall Street, Preston.

NEW BLUE SPOT "CLASS B" OUTPUT UNIT

WE have received from the Blue Spot Co., Ltd., an interesting leaflet giving full particulars of a new unit which should appeal to all home constructors, particularly users of Blue Spot moving-coil speakers. The design of the unit has been carefully considered, so that an existing speaker can be fixed in a few seconds, the whole bolting together and forming a complete and rigid unit. Tone control is fitted, providing means for completely matching the speaker to the set, and also to minimize high-frequency disturbances and background noises. Provision is made for grid bias for the Class "B" valve, where required. The complete unit is of high-class manufacture throughout, and will enable a set to be converted to Class "B" output in a few seconds. The price of the unit, without valve, is 29s. 6d., or with an Osram B21 valve, 43s. 6d. Copies of the leaflet can be obtained from The Blue Spot Company, Ltd., Blue Spot House, 94-96, Rosoman Street, Rosebery Avenue, London, E.C.1.

HEAYBERD MAINS EQUIPMENT

THE well-known firm of Heayberd—manufacturers of practically all types of mains apparatus—have sent us a copy of their new 1934 Combined Handbook and Catalogue, "Mains Power for Your Radio." A special television supplement is included, and this new and enlarged edition should prove even more popular than the previous ones. The home constructor will find this a veritable mine of information, as, instead of being simply a list of their products and prices, this book gives technical hints, and complete circuit diagrams for making up various types of eliminator. With the diagrams is a list of all the components for these eliminators, with prices, enabling any constructor to make up a mains unit to suit both pocket and technical requirements. Particulars are also given of a new type portable battery charger which delivers an output of 1 or 2 amps as desired by means of a change-over switch. No constructor should be without one of these useful handbooks, a copy of which can be obtained for 3d., post free, from F. C. Heayberd & Co., 10, Finsbury Street, London, E.C.2.

This Book Will Help You To Win Money

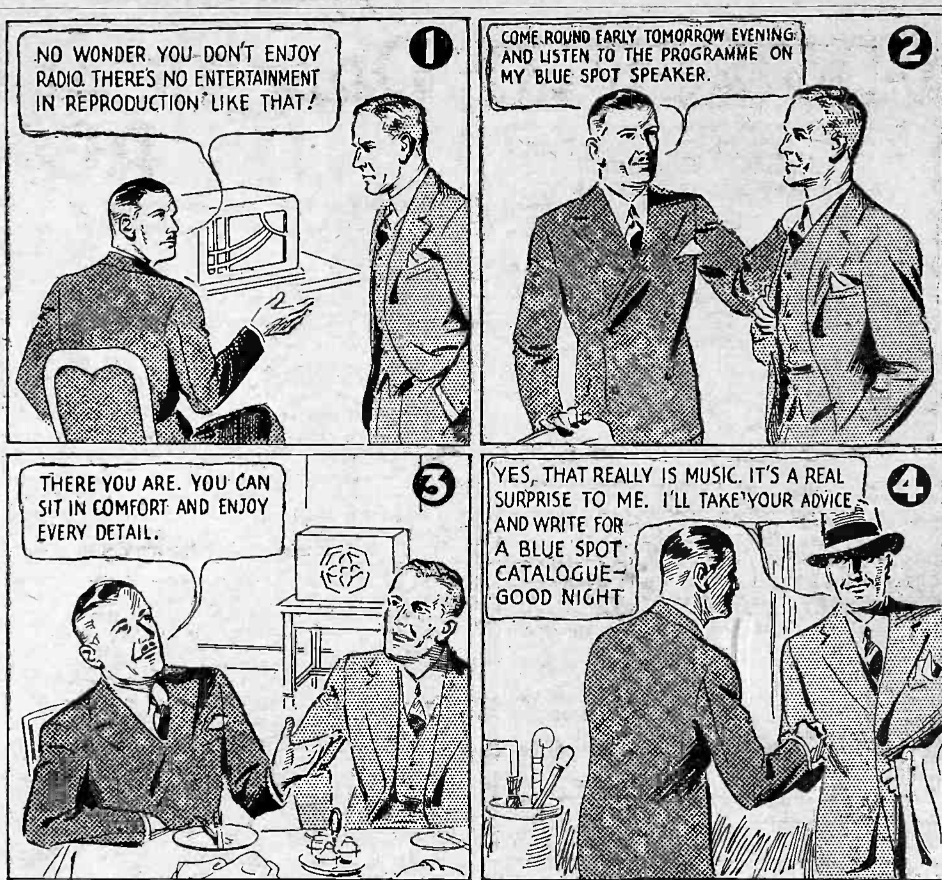
The HANDY RHYMESTER

The Only Book of Its Kind

This concise rhyming dictionary will prove especially valuable to those taking part in Limericks and other popular rhyming contests. It contains practically every word in everyday use, in alphabetical order, classified with other words with which it rhymes.

JUST PUBLISHED

On sale at all Newsagents and Bookstalls, or by post 7½d. from George Newnes, Ltd., 8-11, Southampton St., Strand, London, W.C.2. 6D.



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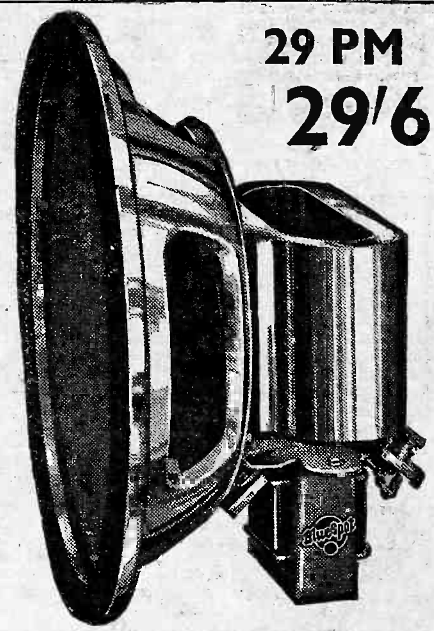

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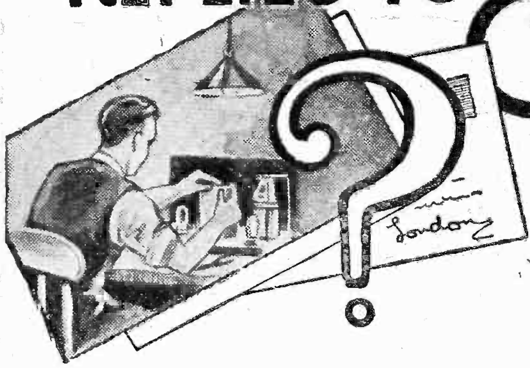

The coupon on this page must be attached to every query.

If a postal reply is desired, a stamped addressed envelope must be enclosed. Every query and drawing which is sent must bear the name and address of the sender. Send your queries to the Editor, PRACTICAL WIRELESS, Geo. Newnes, Ltd., 8-11, Southampton St., Strand, London, W.C.2.

SPECIAL NOTE.

We wish to draw the reader's attention to the fact that the Queries Service is intended only for the solution of problems or difficulties arising from the construction of receivers described in our pages, from articles appearing in our pages, or on general wireless matters. We regret that we cannot, for obvious reasons—

(1) Supply circuit diagrams of complete multi-valve receivers.
(2) Suggest alterations or modifications to receivers described in our contemporaries.
(3) Suggest alterations or modifications to commercial receivers.
(4) Answer queries over the telephone.

Please note also that all sketches and drawings which are sent to us should bear the name and address of the sender.

STROBOSCOPE WANTED

"Re your article on 'Stroboscopes' in "Practical Wireless" last year. Could you please tell me if there is a firm which makes accurate gramophone stroboscopes. I would require one suitable for 50 cycle A.C. mains, with a speed of 78 r.p.m."—A. L. H. (Bristol).

A stroboscope suitable for your purpose may be obtained free of charge from Messrs. Claude Lyons, Ltd., 40, Buckingham Gate, Westminster, S.W.1. Kindly mention this paper when writing for the Stroboscope.

SUP-HET CONVERTER PROBLEM

"I am going to build a superheterodyne converter, but am rather doubtful regarding the correct valves to use. I have read in one book that it would be best to use an ordinary S.G. valve for the detector with a small L.F. for the oscillator, and a friend has a converter similar to the one I wish to make up, but he does not use the S.G. type of valve in the detector position. He tells me that the S.G. valve will not be worth while and that the ordinary medium-impedance type is to be preferred. Could you please help me out and give an explanation of the difference which does exist."—T. Y. (Beckenham).

The valves you refer to may each be used, and the actual choice must be governed by the remainder of the circuit design. With an ordinary three-electrode valve you may find interference is difficult to eliminate, whilst the ordinary S.G. valve may result in double-tuning points. As you have not yet built the circuit we would suggest a modern high-frequency pentode of the variable-mu variety, as this will enable smooth volume control to be obtained and will prevent cross-modulation. The small L.F. type of valve will serve quite well as an oscillator and is probably the best type of valve for this position.

SUPER-HET GANGING

"I had a lot of parts very similar to those you used in the Premier Super. I had home-made L.F. transformers, and with a few new parts which I bought I assembled a circuit on the lines of the Premier. I do not want to claim that I have built your set, but it is to all intents and purposes similar. I find, however, that when I set all trimmers on Fécamp I get this station much too loud for home comfort, yet when I go up the scale the stations get weaker as I go up. London National is not too bad, but the Regional is only just audible. The Midland can be heard if you get right close to the speaker and above this there is nothing. When, however, I set the wavelengths to North Regional and adjust the trimmers, I can get this too loud for comfort, but when I go down to Fécamp I cannot get it. Can you tell me how to get this trimming so that it will remain for all stations."—A. F. G. (Hythe).

The cause of your trouble is in the relation between the tuning coils and the tuning condenser. The coils are wound in such a manner that they require a tuning condenser having a certain "law." If this is attended to you will find that once adjusted the settings will remain at all parts of the dial. If, however, you employ a condenser which does not maintain the correct ratio throughout the scale you will never succeed in ganging the receiver and will always have to adjust the trimmers at every setting. We presume, of course, that you have employed a tracking oscillator section on the ganged condenser, or alternatively have fitted a padding condenser to serve the same purpose.

QUESTIONS NOT TO ASK

1. "Will you please send me a complete circuit diagram incorporating the enclosed list of components?"

Our Free Advice Bureau is a generously interpreted service to readers, but we cannot undertake to design special receivers around individual components. Such queries cannot satisfactorily be answered in a letter.

2. "My wireless set will not work, can you tell me why?"

No one can answer a query of this sort. A doctor requires to know the symptoms before he can diagnose the complaint and suggest a cure. We desire to know, before we can be of assistance, firstly what remedies the querist himself has applied without results; secondly the style of circuit employed; and thirdly, the symptoms.

3. "I enclose a list of call signs. Can you please identify these for me?"

If more than three call signs are included the answer is "No!" We are compelled to place some limit upon this free service owing to the fact that we continually receive lists containing fifty or more call signs.

L.F. OSCILLATION

"I am in some little difficulty about my set. When I tune to weak stations they come through clear and distinct. When, however, I try to get the local or another station which has fair power it seems to choke the speaker and comes through indistinct. I cannot explain the effect any better than this and should be glad if you could assist me. The H.T., G.B. and valves have been tested and found in order. The speaker has also been tested on another set and will handle much more volume than I am getting."—H. B. (Finchley).

The symptoms point to L.F. instability, and you will probably find that a loud signal, or a large input to the output valve (which we suspect is a pentode) results in oscillation. Fit a resistance (about 50,000 ohms) in series with the grid of the output valve, and/or reverse the connections to the secondary of the L.F. transformer. You will, no doubt, find this will cure the trouble. Can you detect a high-pitched whistle whilst the signals are being received? This will give you a certain indication of L.F. oscillation.

BIAS RESISTANCE RATING

"I have built a power amplifier, but am rather worried about the bias resistance. I used the set for two or three weeks with every satisfaction. I then noticed that quality was falling off, and on attempting to test the set I noticed that the output valve was glowing blue. I have read that this indicates over-running and I cannot see how this can be as I have carefully worked out all values. I enclose the circuit, with all ratings, etc., marked and should be glad if you could see where I have tripped up. I notice, by the way, that the covering of the bias resistance is turning brown and this gets very warm. Does it indicate over-running?"—L. K. (Peckham).

You have apparently overlooked the fact that the bias resistance, when connected in the common negative lead, carries the total current of the entire receiver. Thus, you have wrongly estimated its value, as you have (from your figures) worked on the anode current of the output valve only. In view of the greater current which is passed you should have used at least a 5-watt resistance, not the 1-watt which is at present fitted. The over-heating which this has resulted in, has altered the value of the resistance and it is not now giving sufficient bias to the valve. Thus you are damaging the valve by running it under these conditions. You require a 300-ohm resistance, and this should be of the 5-watt type.

TRANSFORMER DIFFERENCES

"I am rather puzzled by a fact which came to my notice recently. Whilst in a radio shop I saw two output transformers of identical make and both of which were of the same ratio. One, however, was provided with a centre-tapped primary, and, although it did not appear to be any larger in size, it was stated that it would carry double the current of the other one. I cannot quite see how this can be so without using heavier wire. Could you explain this point to me?"—G. B. Watford).

The difference lies in the fact that one transformer primary is intended to be connected direct in the anode circuit of an output valve, and the other is intended for use with push-pull circuits. In the former case the total current of the output valve passes through the winding and obviously when a certain value is reached saturation will occur. This, as you know, impairs efficiency and therefore the rating is that which will be the maximum advisable current before saturation. In the case of the push-pull valves, however, the two valves work in such a manner that the currents flowing through the two halves of the primary are in opposition, and therefore they balance out. This means that the same primary winding will obviously be suitable for use with valves which pass a much greater anode current.

FREE ADVICE BUREAU
COUPON

This coupon is available until March 10th, 1934, and must be attached to all letters containing queries.

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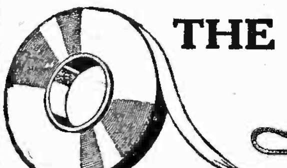
THE WORLD'S HANDIEST AERIAL



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Miscellaneous Advertisements

Advertisements are accepted for these columns at the rate of 3d. per word prepaid — minimum charge 3/- per paragraph—and must reach this office not later than Tuesday for the following week's issue. All communications should be addressed to the Advertisement Manager, "Practical Wireless," 8 Southampton Street, Strand, London.

PREMIER SUPPLY STORES

offer the following Set Manufacturers' Surplus New Goods at a fraction of the original cost; all goods guaranteed perfect: carriage paid over 5/-, under 5/- postage 6d. extra (Ireland, carriage forward).

PREMIER SUPPLY STORES announce the purchase of the entire stock of a world-famous Continental valve manufacturer. All the following types of standard mains valves at 4/6 each. H. HL. L. Power. Directly heated 6-watt Pentode. Directly-heated 9-watt Pentode. High magnification Screen-grid, low magnification Screen-grid. Variable-Mu Screen-grid. 250 volt 60 milliamp. full-wave rectifiers.

THE following types 5/6 each. Indirectly-heated Pentode. 350 volt 120 milliamp. full-wave Rectifier. 500 v. 120 ditto, 6/6. Dario Battery Valves 4v. filament. Set of 3, consisting of Screen-Grid, Detector and Power or Super-Power, 6/6 the lot. Power or Super-Power, 2/6.

ELIMINATOR Kits, including transformer, choke, Westinghouse metal rectifier, Dubilier condensers, resistances and diagram, 120v. 20 m.a., 20/-; trickle charger 8/- extra; 150v. 30 milliamps., with 4v. 2-4 amps. C.T. L.T., 25/-, trickle charger 6/6 extra; 250v. 60 milliamps., with 4v. 3-5 amps. C.T. L.T., 30/-; 300v. 60 m.a., with 4 volts 3-5 amps. C.T. L.T., 37/6; 150 volts 50 milliamps, 27/6.

AMERICAN Triple Gang 0.0005 Condensers, with trimmers, 4/11; Premier chokes, 25 milliamps, 20 Henries, 2/9; 40 milliamps. 25 hys., 4/-; 65 milliamps. 30 hys., 5/6; 150 milliamps. 30 hys., 10/6; 60 milliamps. 80 hys., 2,500 ohms, 5/6.

HARLEY Pick-up, complete with arm and volume control, 12/6.

BRITISH RADIOPHONE Wire Wound Potentiometers, with mains switch incorporated, 10,000 ohms, 3/6.

PREMIER British-made Meters, moving iron, flush mounting, accurate, 0-10, 0-15, 0-50, 0-100, 0-250 ma., 0-1, 0-5 amps.; all at 6/-.

SPECIAL Offer of Mains Transformers, manufactured by Philips, input 100-120v. or 200-250v., output 180-0-180 volts 40 m.a., 4v. 1 amp., 4v. 3 amp., 4/6; 200-0-200v., 4v. 1a., 4v. 3a., 4/6.

ALL Premier Guaranteed Mains Transformers have Engraved Terminal Strips, with terminal connections, input 200-250v. 40-100 cycles, all windings paper interleaved.

PREMIER H.T.8 Transformers, 250v. 60 m.a., rectified with 4v. 3-5a. and 4v. 1a. C.T. L.T., screen primary, 15/-; with Westinghouse rectifier, 25/-.

4V. 3a. C.T., 6v. 2a. C.T., 9v. 1a., 12v. 1a., 7/6 each; 4v. 3-5a., 22v. 1a., 8/6 each; 10v. 3a., 14v. 4a., 10/- each.

PREMIER H.T.9 Transformer 300v. 60 m.a., with 4v. 3-5a. and 4v. 1a. C.T., L.T., and screened primary, 15/-; with Westinghouse rectifier, 26/-.

PREMIER H.T.10 Transformer, 200v. 100 m.a., rectified, with 4v. 3-5a. and 4v. 1a. C.T., L.T., and screened primary, 15/-; with Westinghouse rectifier, 26/-.

PREMIER Mains Transformers, output 135v. 80 m.a. for voltage doubling, 8/6; 4v, 3-4a., C.T., L.T., 2/- extra; Westinghouse rectifier for above, giving 200v. 30 m.a., 8/6.

PREMIER Mains Transformers, output 250-0-250v. 60 m.a., 4v. 3-5a., 4v. 2-3a., 4v. 1-2a.(all C.T.); with screened primary, 15/-.

PREMIER Mains Transformers, output 350-0-350v. 90 m.a., 4v. 3-5a., 4v. 2-3a., 4v. 1-2a. (all C.T.), with screened primary, 15/-.

PREMIER Mains Transformers, output 400-0-400v. 100 m.a., 4v. 4-5a., 4v. 2-3a., with screened primary, 15/-.

PREMIER Auto-Transformers, 100-110/200-250v., or vice versa, 100-watt, 10/-.

MULTI Ratio Output Transformers, 4/6, Twin Screened Wire 3d. per yard.

CENTRALAB Potentiometers, 50,000, 250,000 half meg., any value, 2/-; 200 and 400 ohms, 1/-.

RELIABLE Canned Coils with Circuit, accurately matched, dual range, 3/- per coil. Please state whether Aerial or H.F. required. Ditto iron core, 3/6.

PREMIER L.T. Supply Units, consisting of Premier Transformer and Westinghouse rectifier, input 200-250v. A.C., output, 2v. ½amp., 11/-; 8v. ½amp., 14/6; 8v. 1 amp., 17/6; 15v. 1 amp., 19/-; 6v. 2 amp., 27/6; 30v. 1 amp., 37/6.

MAGNAVOX D.C. 152, 2,500 ohms, 17/6; D.C. 154, 2,500 ohms, 12/6; D.C. 152 Magna, 2,500 ohms, 37/6, all complete with humbucking coils; please state whether power or pentode required; A.C. conversion kit for above types, 10/-; Magnavox P.M., 7in. cone, 18/6.

GRAMPIAN M.C. Loud Speakers, 2,500 ohm field, 9in. cone, handles 5 watts; 21/-.

GRAMPIAN P.M. Loud-speakers, 9in. cone, handles 4 watts; 18/6.

(Continued at top of column three)

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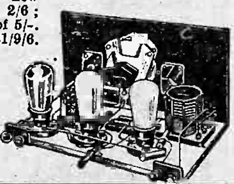

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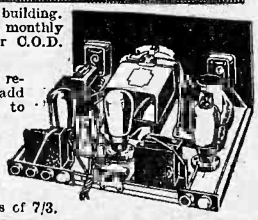

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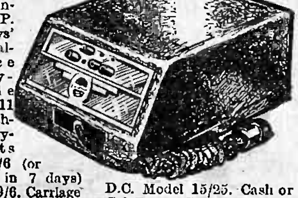

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(Continued from foot of column one)

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EDISON BELL Double Spring Gramophone Motors, complete with turntable and all fittings, a really sound job, 15/-.

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WIRE Wound Potentiometers, 15,000 ohms, 1/6; 50,000 ohms, 2/-; 500,000 ohms, 3/-.

HOME Radio Microphone, complete, 5/-; simply plug in to pick-up terminals.

A LARGE Selection of Pedestal, table and radiogram cabinets, by best manufacturers, at a fraction of original cost for callers.

WESTERN ELECTRIC Mains Transformers, 500-0-500v. 150 m.a., 4v. 3-5a., 4v. 2-3a., 4v. 2-3a., 4v. 1a. C.T., 4v. 1a. C.T., 19/6.

1,000 Ohm 150 m.a. Wire Wound Variable Resistance, 2/-; Burndept 2-watt resistances, all values from 0.5 to 50 ohms. 3d. each: holders, 2d. each.

T.C.C. Condensers, 250v. working; 2 mf., 1/9.

T.C.C. Electrolytic Condensers, 440 volts working, 8 mf., 3/-; 15 mf., 50v. working, and 50 mf. 12v. working, 1/-; 25 mf. 25v. working, 1/3.

T.C.C. Block Condensers, 250v. working, 2 x 2 x 2 x 0.1, 2/-; 2 x 2 x 2 x 1, 2/3; the above condensers at same price by Dubilier 300v. working.

H.M.V. Block Condensers, 400v. working; 4 x 4 x 1 x 1 x 1 x 1 x 0.1 x 0.1 x 0.1, 6/-; 4 x 2 x 1 x 1 x 1 x 0.5, 4/6.

DUBILIER Condensers, 2 mf. 1,200v. working, 4/-; 8 mfd. dry electrolytic, 450v. working, 3/-.

THE Following Lines 6d. each, or 5/- per dozen.—Chassis valve holders, 5, 6 or 7 Pin, screened screen-grid leads, any value 1-watt wire end resistances, wire end condensers, 0.0001 to 0.1, R.I. .0005 varicaps, trimming condensers, T.C.C. 6mfd. 50v. electrolytics.

PLEASE mention PRACTICAL WIRELESS when ordering.

PREMIER SUPPLY STORES

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THE following valves are guaranteed unused and perfect, and any valve differing from the makers' characteristics will be exchanged; and all latest types. A.C/Pens, P.T.4s, A.C.S.G./V.M.s, Pen.4.Vs, M.V.S.G.s, D.P./Pens. A.C.S.2/Pens. M.M.4Vs. P.T.625s, V.M.S.4s, D.C.2/Pens, D.P.T.s, P.M.24M.s, M.P.T.4s, V.M.4V.s, A.C.S.1/V.M.s, P.M.24B.s, D.C.2.S.G.V.Ms., S.P.4s, 11/-; M.S.4s, M.S.4B.s, A.C.S.G.s, S.4V.A.s, S.4.V.B.s, M.S.G./L.A.s, D.S.B.s, A.C.S/2s, D.C.2S.G.s, 9/6. "Class B": P.M.2.B., P.D.220, 220.B., 8/6, M.L.4s, A.C.P.s, P.M.24s, 8/-; A.C./HL.s, 164V.s, 354V.s, A.C.2/H.L.s, 41M.H.L.s, U.10s, U.U.60/250s, M.H.4s, M.H.L.4s, 7/6; V.S.2s, 215S.G.s, 220S.G.s, P.M.12s, 9/-; 442B.U.s, D.W.3s, 8/6; 215P.s, 220P.s, L.P.s, 5/-; P.T.2s, P.M.22A.s, 9/-; H.L.210s, H.210s, L210s, L.2s, 4/. All types of Brand New American Valves in Stock, first-class makes: 247s, 235s, 224s, 236s, 237s, 233s, 18's, 15's, 59's, 58's, 89's, 238s, 239s, 244s, 12/-; 227s, 226s, 245s, 280s, 9/6; 242s, 232s, 11/-; U.X.250s, 281s, 17/6. Dubilier or Erie resistors 1 watt type, 7d. Westinghouse rectifiers unused H.T.S, 10/-; H.T.9, H.T.10, 11/3. Dubilier or T.C.C. electrolytic condensers 8 M.F.D., 3/9. Magnavox, D.C. 152 (2,500 ohms) or 6.500 ohms, 9in. cone, 25/-. Superhet Radiopaks £2/12/6. "Clydesdale" Eliminators, unused, D.C. 12/6. A.C. (Westinghouse) 25/-. Carriage Paid. Cash with Order or c.o.d.—Ward, 45, Farringdon St., E.C.1. Holborn 9703.

RAD-AUTO-GRAM buy Modern Second-Hand Components for Cash.—39, Tulketh St., Southport.

ERICSSON 3/1 L.F. Transformers. List Price, 17s. 6d. New and guaranteed. Our price, 2s. 3d. post free U.K.—Pioneer Radio, Coptic St., London, W.C.1.

REPAIRS—REWINDING—OVERHAULS. Loud speakers, 4/-; Blue Spots, 5/-. New cones fitted to Moving Coil speakers, 6/-. Eliminators, Mains transformers, etc., quoted for. Special components and sets made to order. Quick service. Laboratory tested. Repair Dept. C., Weedon Power Link Radio Co., 80, Lonsdale Avenue, East Ham, London, E.6. 'Phone Grangewood 1837.

OPPORTUNITY.—New "Fury Super" Kit. List, £6 3s.—£4.—151, Wellingborough Road, Northampton.

BLUE SPOT 66K, 6/9. Igranic Transformers, 3-1, 5-1, 3/3. Post paid. Wonder Microphone 4/9. Celestion PPMW. Listed 49/6. 21/6.—Heath Radio, 2, Heath Road, S.W.8.

PEARL & PEARL

190, Bishopsgate, London, E.C.2. All the following bargains guaranteed new goods. Cash or C.O.D. Carriage Paid.

IGRANIC Short-wave H.F. Choke, 10-120 metres baseboard or panel mounting, 1/6 each.

IGRANIC Short-wave inductance coils. In sets of 4 coils, 2, 4, 6, and 9 turns each, 3/11 per set.

THE "Lincoln Super" Permanent Magnet Moving Coil Loudspeaker, all purpose universal tapped transformer for Q.P.P. Class B. Pentode, Power and Super-Power output. Will carry 3 watts undistorted output. List price 42/-. Our price 19/6.

BLUE SPOT 31K Cabinet Speaker with built in volume and tone control. Price 16/11.

IGRANIPAK complete tuning unit, comprising (1) Completely screened coils with built-in wavechange Switch; (2) Igranic 3-gang Condenser with cover; (3) Escutcheon and Disc Drive Assembly with pilot lamp attachment; (4) Mains Switch; (5) Three 5-pin Valve holders; (6) Grid Leak and Condenser; (7) Engraved Terminal Board. Complete with circuit; actually made for A.C. mains, but can easily be adapted for battery sets. List price 57/6, our price 27/11.

WALNUT Moving Coil Loudspeaker Cabinets, will take all standard speakers. Highly polished. Price 9/11.

IGRANIC Screened Iron Core Dual Range Coils. Wave range, 210-510 and 850-2,200 metres. Complete with wave change switch. Our price 5/11.

DITTO, as above, but for short wave lengths of 13.8-27.5 and 27-78 metres. List price 12/6, our price 5/11.

LEWCOS all-wave chokes, 15-200 metres, completely screened. List price 6/6, our price 3/6.

IGRANIC Indigraph Vernier Dials. List price 6/-. Our price 2/11.

DITTO, as above, with micrometer adjustment. List price 7/6. Our price 3/6.

IGRANIC tapped C.C. output unit. Acts as an auto-transformer giving either a step-up or step-down effect to suit any type of loudspeaker employed. List price 8/6. Our price 4/11.

IGRANIC Potential divider has a total resistance of 1,500 ohms. List price 10/6. Our price 3/11.

LINCOLN STEWART A.C. Eliminators, 200-250 volt input, 25 m.a. output, 3 positive and one negative tappings. List price, £2.19.6. Bargain, 32/6.

SLEKTUN Super L.F. Transformer, in moulded bakelite case, ratio 3-1. List price 8/6. Our price 3/11.

IGRANIC Class B. Driver transformer. Tapped 1 to 1 and 1½ to 1. List price 11/6. Our price 5/6.

IGRANIC Micro Variable Condensers. Capacity .00004 mfd., ideal for short-wave work, baseboard mounting. Price 1/6.

BLUESPOT 66K 4 pole balanced Armature Speaker Unit, complete with adjusting spindle, chassis fittings and cone grips. List price 15/-. Bargain price 7/11.

BLUE SPOT Chassis and baffle for above, to clear 4/9.

SPECIAL SUNDRY BARGAINS. (Cash with order only). Igranic 400 ohms, baseboard potentiometers 9d. Edison Bell pick-up arms 1/6. Lots of 3 doz. assorted Dubilier fixed condensers, 1/9 each lot. C.E.C. 1 mfd. condensers 1/3 each. Climax Binocular H.F. Chokes, 1/11 each. Slektun Screened Dual Range Coils, 2/11 each.

REMAINING Stock of Horizontal Set and Speaker Cabinets. Solid polished walnut (made for Philco), 22ins. wide, 10½ins. deep, 11ins high. Price 6/11, cost £1 to make. This item carriage forward.

PEARL & PEARL

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EPOCH.—Annual sale of surplus loud speakers of all kinds, also sets, amplifiers, cabinets, and useful parts of every description for experimenters and wireless dealers; thousands of bargains for callers; second abridged list on application.

EPOCH.—Great bargain in 11in. super P.M. speakers, the finest moving coil in its class; these units are brand new, perfect, and guaranteed 12 months; they are slightly different from standard in design, but equally as good in performance; optional with 10-ratio or Class B transformers; worth 45/-, to clear at £1 each, carriage paid.

EPOCH RADIO, Exmouth House, Exmouth Street, E.C.1 (at junction of Rosebery Avenue and Farringdon Road).

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N.P. Home Chargers, 20/- to 32/6. L.T. and H.T. Lists.

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RADIOMART—Utility 40mmfd. Ball-bearing Short-wave microvariables, 1/9, 2/6, snap switches, 9d.

RADIOMART—Utility Ball-bearing air-spaced Differentials, .0003 and .0005. List 11/6. Finest made, 2/-

RADIOMART—Utility bakelite tuning and reaction condensers, .0005, 10d.; .0003, 8d.

RADIOMART—Igranicore 1934 super, 12/6. Iron-core dual range short-wave inductance coils, 4/9. Ditto H.F. chokes, 1/-

RADIOMART—Set 4 Latest Igranic, 11/6. Short-wave inductance coils, 15-130 metres, 4/-

RADIOMART—Igranic boxed L.F. transformers, parafeed type, 3/-. Ditto, 3-1 and 5-1, 10/6. Nickel core, 3/11.

RADIOMART—Screened iron-core dual-range coils, with instructions, 2/11. Climax binocular HFC. 1/6.

RADIOMART—Genuine Varley "Niclet" nickel-core manufacturers' transformers, 2/-. Amplion speaker units, 2/-

RADIOMART—Philco heavy duty Class "B" 1-1 driver transformers, boxed, 2/9. Valve-holder baseboard, 9d.

RADIOMART—British Radiophone, 7/6. Wire-wound logarithmic potentiometer, with mains switch, 10,000, ditto 5,000; heavy duty no switch, either type 2/-.

RADIOMART—Lotus 3½-1 push-pull inter-valve manufacturing tag connections, 2/-. Special offer H.M.V., Philips, Lotus 1-watt resistances.

RADIOMART—New Purchase Met-Vick, 35/-. Super transformers, 250/250, 4v2a, 4v. up to 5 amps., fitted terminals, 9/6. 100v. or 230v., 25 cycles, 12/6.

RADIOMART—Western Electric sensitive microphone insets, 1/-. Paxolin type formers, 2d.; 2in. ribbed ebonite, 4d.

RADIOMART—Erie 1-watt resistances, 100, 250, 300, 350, 400, 450, 500, 750, 1,000, 5,000, 10,000, 15,000, 20,000, 25,000, 27,000, 30,000, 35,000, 50,000, ¼ meg., 1 meg., 8d. each, 6/9 dozen.

RADIOMART—Guaranteed prompt despatch, perfect goods; no misrepresentation.—The Square Dealers, 19, John Bright Street, Birmingham.

A.C. Eliminators, Alco, 105-250v. outputs 60v. SG. 130v. 20 M.A., 24/-; with charger 35/-. Complete and guaranteed.—P. & D. Radio, 1, Goodinge Road, N.7.

"MELFO-RAD" Guaranteed Specified Kit Service. "The Leader 3," described within, 43/- complete. Orbit Three, £3 13s. 6d., ST.500, 78/-, Fury Super, £6 3s. 0d. Television Disc Receiver Kits, 50/- complete. Lists Free.—5, Queens Pl., Hove. (Trade supplied.)

WANTED Mains and Battery Valves, also clean surplus components.—Newport Surplus Stores, 24a, Newport Court, Charing Cross Road, W.C.2.

FIFTY 1934 Model Three-Valve Receivers, complete M.C. Speakers, Valves, Batteries. Beautiful Oak Cabinets. List £5 17s. 6d. Sample Set £3 17s. 6d. C.W.O., carriage paid. Makers' guarantee.—A. L. Burt, 11a, Kingsbury Road, Birmingham.

MOTORS. Clearance lines for radiograms and gramophones, electric or clockwork. Prices from 6/6. Send for list.—H. L. Smith & Co. Ltd., 289, Edgware Road, W.2. Tel.: Padd. 5891.

RADIOGRAM Cabinets, manufacturers' clearance.—Brunswick (Model 70), 45/-; Zetavox (Model A.G.), 50/-; Table Radio Cabinets, Philco Model 237, 22 x 11 x 10½, 10/6; huge stock of all kinds of cabinets.—H. L. Smith and Co., Ltd., 289, Edgware Rd., London, W.2. Tel.: Pad. 5891.

RADIO Agencies, offer Set Manufacturers Brand New SURPLUS Rola Moving Coil Speakers in following voltages; state if Power or Pentode. All incorporate Humbuckers. 2,000, 2,500, or 6,500 ohms F6 (list, 35/-) at 18/-; F.7 (list, 47/6) at 25/-; Permanent Magnets, F.6 P.M. (list, 49/6) at 28/-; F.7 P.M. (list, £3) at 33/-; if class "B" Transformer, 2/- extra. Blue Spot lines: 66K Unit (list, 15/-) at 8/-; 66K unit and chassis complete at 13/6. Blue Spot Pick-ups, Type 88 (list, 3 guineas), with Volume Control, at 26/-; B.T.H. Senior, with control, de Luxe (list, 37/6), at 28/-. All goods Carr. Paid. Cash with order or C.O.D.—Radio Agencies, 4/21, Upper Marylebone Street, London, W.1.

VOLTMETERS, Watch Type, read 120 volts H.T., 12 volts L.T., in case, 2/3, cash with order. Rola P.M. Speakers (list, 39/6), with Universal Transformer, 19/6. All New and Guaranteed. C.O.D. or cash with order. Eagle Radio, 165, Hedge Lane, Palmers Green, London, N.13.

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New Stock Guaranteed Parts

KIT of Components and all Sundries, 37/6; with set of Tested Matched Valves, 56/6; with Valves and Batteries - - 63/9. PACKED IN SEALED CARTON.

CASH or C.O.D. POST FREE. **37/6** ALL COMPONENTS and SUNDRIES.

ALL COMPONENTS OF EXACT SPECIFIED VALUES

THE DIRECT TRADING COMPANY

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SOUTHERN RADIO'S Bargains.—Set manufacturer's guaranteed surplus.

VARIABLE Condensers.—Lotus 3-gang 0.0005, 12/6; Lotus 2-gang, 0.0005, 8/6; Lotus Dyblock single, 0.0005, 4/9 (list 9/6); all these condensers are complete with dials, escutcheons, knobs, fully screened with trimmers, and boxed; Igranic variable, 0.0003 and 0.0005, 2/3; Hydra block condenser, 16 mfd. (2+2+8+2+1+1), 1,000 v. D.C., 7/- each; 20 mfd. (2+2+2+2+2+2+2+2+1+1+1+1), 1,500 v. D.C., with terminals, 11/6; Dubilier 4 mfd. (2+1+1), 1,000 v. D.C., 2/9; 4.5 mfd. (2.25+2.25), 3/-; fixed 4 mfd., 2/3; 2 mfd., 1/6; 1 mfd., 1/-.

SPEAKERS.—Blue Spot permanent magnet, with Universal transformer for power, pentode, super power or class B, 23/- (list 39/6); D.C. mains energised, all voltages, 16/6; Celestion Soundex P.P.M. permanent magnet, 17/6 (list 27/6); Blue Spot 100U inductor, complete with chassis, 13/6 (list 39/6); Celestion permanent magnet type P.P.M.W. universal transformer, 25/- (list 49/6).

BLUE Spot, 66K, complete in cabinet, 16/- (list 42/6); G.E.C. Stork, in magnificent cabinet, 19/6 (list £3/15); all speakers new in original cartons.

PICK-UPS.—B.T.H. Senior 1934 model, with volume control, 28/6 (list 37/6); Blue Spot, model "88," with volume control, 26/- (list 63/-); Marconi No. 19 (1934), 26/- (list 32/6).

CONSTRUCTORS' Kits.—Ready Radio Meteor "A" 3-valve screened grid kits, with cabinet and moving coil speaker, less valves, £3/7/6; with valves, £4/10 (list £8/7/6); Ready Radio S.T.400 kits, all specified components, by Scott Taggart, £2/19/6 (list £4/17/6).

FRAME Aerials.—Lewcos dual wave 235-550 metres and 1,000-2,000 metres, 10/- each (list 37/6).

IGRANIPAK complete tuning unit, comprising (1) Completely screened coils with built-in wavechange switch; (2) Igranic 3-gang Condenser with cover; (3) Escutcheon and Disc Drive Assembly with pilot lamp attachment; (4) Mains Switch; (5) Three 5-pin Valve holders; (6) Grid Leak and Condenser; (7) Engraved Terminal Board. Complete with circuit. List price 57/6. Our price, 26/-.

MISCELLANEOUS.—Ferrocart coils, G.1, G.2, G.3, with switch, 31/9 (list 39/6); Benjamin Class "B" universal output chokes, 6/6 (list 11/-); Ready Radio Instamat Universal transformers, for matching any value to speaker, 11/6 (list 37/6); Rotorohm and Radiophone volume controls, all values, 3/- each; with switch, 3/3 (list 10/6); S.T.500 coils, 5/6 per pair; Hellesen's 8 mfd. electrolytic condensers, 2/9 each; Westinghouse metal rectifiers, H.T. 6, 7, 8, 9/3 each; Amplion loud-speaker units, 2/3; Ferranti choke, 20 henry 60 m.a., 6/9 each; Kolster Brandes gramophone motors, dual, for A.C. or clockwork, complete with turntable and all accessories, 110-250 volts, 25/- each (list 63/-); Ready Radio L.F. transformers, 5-1, 3-1, 3/3 (list 8/6); B.T.H. transformers, 3/6; Lewcos superhet 8-way bases, complete with valve holders, grid leak, fixed condenser, type "48," 2/- each.

SPECIAL Bargain Offer of Lewcos Spaghetti Resistances. All sizes in originalse aled boxes, 4/- per dozen. Assorted. Special Price to the trade, 36/- per gross.

RECEIVERS.—G.E.C. Osram Music Magnet 4. A.C. Model, 110/250 volts, complete with "B.C. 1532" Power Unit and G.E.C. Permanent Magnet Speaker in magnificent Floor Cabinet and 4 Osram A.C. Valves. Brand New 1934 series in original sealed cartons, £8 15s. each (List, £21).

BURGOYNE "Popular" 3-Valve Battery Set. Complete with 3 Mullard Valves, Exide Batteries, etc., and Speaker in attractive transportable Cabinet. £3. Brand New, in original cartons. Every set guaranteed.

MAINS Transformers and Chokes.—Please send for complete list; specials can be supplied within 3 days of order.

ALL Transformer and Chokes Guaranteed for 12 months.

ALL Goods Guaranteed and Sent Carriage Paid.

BRANCHES at 271-275, High Rd., Willesden Green, N.W.10, and at 46, Lisle St., W.C.2; please send all post orders to 323, Euston Rd., N.W.1.

SOUTHERN RADIO, 323, Euston Rd., London, N.W.1 (near Warren St. Tube). 'Phone: Museum 6324.

GRAMOPHONES. Radiograms, 64 page. How to make 'm, 3d. Motors, Arms, Pick-Ups, Speakers, Horns, Springs, Repairs, Accordions. Regentprac, 120, Old Street, London, E.C.1.

MICROPHONES.—Buy from the actual makers at Rock bottom Prices. Button capsules complete for detectaphone and other experiments, only 1/-. Transformer, 3/6. No. 11 Home Mike, bakelite body, 2in. diam., unbreakable, 5/6. Table PW.11, a handsome announcer's rectangular model, 3in. by 3in., on brass stand, a self-contained Mike and Transformer, with switch, 10/6. Tall pedestal Broadcasting Model 12B, with Microphone hung in ring, 12in. high, 18/6. Complete Deaf Aid sets to assist those hard of hearing, 18/6. Special P.A. makes for Dance Bands and Public address. All parts in stock for Home Constructors, granules, blocks, diaphragms, mouthpieces, etc. Headphones, 2/6 pair. Write for Lists "N" 1 and 2.—Electradix Radios, 218, Upper Thames Street, London, E.C.4. Tele.: Central 4611.

SURPLUS Stock of Wireless Sets and Components for disposal. Send for list.—W. Burns and Co., 287, City Road, E.C.1.

THE 'GOLD-MINE STORES'

Offer You 'The Leader III.' 25/6 post free

L.E.C. GUARANTEE. FREE APPROVAL. Your satisfaction complete or money returned without question. The Leader III kit is made up exact to specified values and of first quality components throughout. The price alone falls short of this standard. We guarantee your satisfaction, so why pay more. We will send on full approval against cash or C.O.D This is the best 'Lucerne kit' yet. Tunes from 150 metres. (See also our advertisement on page 1113.)

THE LEADER III, KIT A. Complete to the last screw, with chassis, all components, sundries, blueprint and copy of PRACTICAL WIRELESS. Post paid, 25/6.

LEADER III, KIT B. as above but with matched set of three British and fully guaranteed valves. Price 36/6.

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THE 'RADIO GOLD-MINE' costs you 3d. Saves you pounds. Send to-day.

L.E.C. MAINS TRANSFORMER BARGAINS.—Inputs, 200-250 v.; Special Lotus 80 m.a., 350.0.350 v., 4 v. 2 a., 4 v. 4 a., C.T. 4 v. 2 a., 6/11; Kenwell, 200.0.200, 4 v. 2 a., 50 m.a., 4/10; H.T. 9 Transformer, 300 v. 60 m.a., rectified with 4 v. 4 a., 4 v. 1 a., C.T., 6/11; H.T. 8, 180 v. 60 m.a., with 4 v. 3 a., 4 v. 1 a., C.T., 5/10; H.T. 7, 150 v. 25 m.a., 3/11; G.E.C. 20 men. Chokes (list 15/6), 3/11.

THE 'RADIO GOLD-MINE' the indispensable guide to all surplus stocks; 3d. post free.

L.E.C. MANSBRIDGE CONDENSER BARGAINS. —1 mfd. 9d.; 2 mfd., 1/4; 4 mfd., 2/8; 14 mfd. (6:3:2:1:1:1), 5/10; All Philips 750v. test.

L.E.C. FIXED CONDENSER BARGAINS.—Dubilier and Edison Bell, Mica, .0001, 2, 3, 4, 5 mfd.; .001, 2, 3, 4, 5, 6, 7, 8, 9 mfd.; Tubular mica type, .0001, .0003 mfd., all 3d. each; 2/9 doz.

THE 'RADIO GOLD-MINE' for quality goods at the lowest liquidation prices ever! 3d. post free.

L.E.C. RESISTANCE BARGAINS.—Special H.M.V. 4 watt glass cased, 100,000 ohms, 4½d.; Erie, 1 watt, all values to 60,000 ohms, 4½d.; Dubilier, 1 watt, 100,000 ohms, 3d.; Philco, 2, 10, 15, 16, 20 and 32,000 ohms, 3½d.; Edison Bell Carbon to 70,000 ohms, 4½d.; to 150,000, 5d.; to 350,000, 5½d.; to 500,000, 6d.; Spaghettis, every size to 100,000 ohms, 5d.; Higher values, 7d.; Grid Leaks, ½ to 3 megs., 3d. each.

THE 'RADIO GOLD-MINE.' Radio's greatest surplus lists for 3d. that will save you pounds.

L.E.C. 'GOLD-MINE' MIKE, 3/11. A simple but amazingly efficient microphone at a 'knock out' price. Two models, hand or pendant, with diagrams, 3/11 each.

L.E.C. SUNDRY COMPONENT BARGAINS.—Special Dario L.F. Transformers, 3:1 and 5:1, 1/10; Cl. B. Driver, 3/11; Output Chokes, 3/11; Amplion Speaker Units, 1/8; H.F. Chokes, 9d.; V-holders, 4 pin, 2½d.; 5-pin, 3½d.; 7-pin, 6d.; Switches, push-pull, 2-point, 4½d.; 3-point, 5½d.; Grid Leaks, ½, 1, 1½, 2, 3 megs, 3d. each.

THE 'RADIO GOLD-MINE.'—Don't delay. Secure yours to-day, 3d. post free.

L.E.C. COIL BARGAINS.—All dual range with reaction. Brownie, 1/-; Screened, 2/6; Special Iron Cored, 3/3 (diagrams included); S. Wave, 2/6.

L.E.C. VARIABLE CONDENSER BARGAINS.—.0003, .0005 mfd., 2/3; Slow Motion Type, 2/11; Small Line, 11d.; 2-gang, .0005 with S.M. drive, 6/11; 'Duotune' Extensers (list 12/6), 2/11; S.M. Type (list 18/6), 4/10.

L.E.C. SPEAKER BARGAINS.—Special job offer. Motor P.M.M.C. Speakers. List, 45/-; Brand new in boxes, 12/6 each; Amplion Cone Units (worth 7/6), 1/8 each.

L.E.C. ELIMINATOR BARGAINS, 25 ma. output, 4 voltages to 140 v. A.C. model, 24/6; D.C. 12/6. State mains voltage.

THE 'RADIO GOLD-MINE.'—You literally cannot afford (for only 3d.) to be without it.

L.E.C. 'GOLD-MINE' KIT BARGAINS.—St. II, 8/6; St. III, 10/6; S.W. III, 18/6; adaptor, 8/6; Cl. B adaptor, 10/6. Complete in sealed cartons with diagrams, instructions and all sundries.

L.E.C. VALVE BARGAINS.—All British and guaranteed: 2 v. battery, H.F., Det., L.F., 2/11; Power, 3/3; S.G., 4/10; Class B, 9/-.

THE 'RADIO GOLD-MINE' at 3d., post free, is the greatest investment you will ever make. The most comprehensive lists of up-to-date surplus goods (kits, components and accessories) yet produced; with a general price level absolutely the lowest ever! March first issue now ready. We expect it to break all records! Do not delay. Send (enclosing 3d. stamps) to-day.

LONDON EAST CENTRAL TRADING COMPANY (Dept. M. 101), 23, Bartholomew Close, London, E.C. 1 (telephone: NATional 8523). Goods over 10/- value, postage free. Under 5/- value—cash only. Over 5/- cash or C.O.D. (Further announcement on page 1113.)

For Everything Surplus in Modern Radio

THE 'GOLD-MINE STORES'

MODERN Radio present the following picked selection of new bankrupt stock and manufacturers' surplus. All goods guaranteed up to standard and sent post free. Give us a trial, you will not be disappointed. Enquiries must bear a stamped addressed envelope.

MARCONI model 19 pick-ups listed 32/6, 26/-. Harlie 1934 type pick-ups, with volume control, rest, tension adjuster, and twist head, listed 21/-, 12/6. Igranic midget transformers, 3-1 and 5-1, listed 10/6, 3/11 each.

METRO Vick type A and B transformers, for 200-240 volts input, outputs 250-0-250 volts 60 milliamps, 4 volts 5 amps, 4 volts 2 amps, listed 37/6, 10/6. Wonderfully finished job, massive iron clamps, all terminals fitted on marked panel.

KOLSTER Brandes model 287 loud-speaker in solid oak cabinet, sloping sides, splendid volume, clear tone, listed 42/-, 10/6.

ESTON Iron core dual range coils, suitable for ganging, circuit free with every one, fully screened, 3/3.

GE.C. 4 mfd. fixed condensers, tested to 1,500 volts, in tin case with terminals, 2/9 each.

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